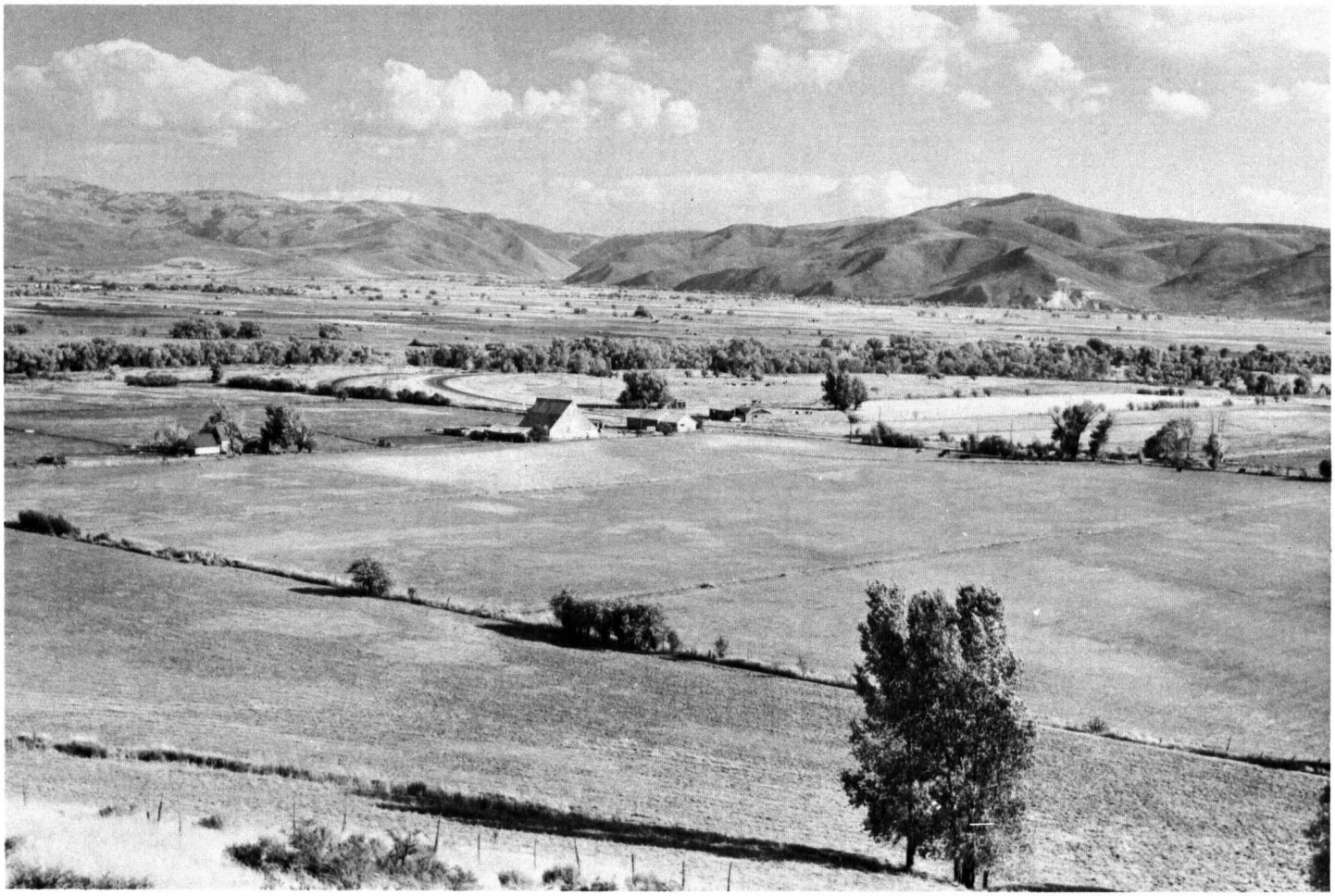
SOIL SURVEY OF

Heber Valley Area, Utah

Parts of Wasatch and Utah Counties



United States Department of Agriculture
Soil Conservation Service and Forest Service
in cooperation with
Utah Agricultural Experiment Station

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, wildlife, and recreation.

Locating Soils

All of the soils of this survey area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all of the soils in the county in alphabetic order by map symbol and gives the capability classification, the range site, and the wildlife suitability group of each. It also shows the page where each soil is described and the pages for the capability unit and the range site to which the soil has been assigned.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about the use and management of the soils from the section "Management for Crops," from the soil descriptions, and from the discussions of the capability units.

Ranchers and others can find, under "Range Management," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers, builders, and community planners can find, under "Engineering Applications," tables that contain estimates of soil properties and information about soil features that affect engineering practices.

Game managers, sportsmen, and others concerned with wildlife can find information of interest in the section "Wildlife Habitat."

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in the survey area may be especially interested in the section "General Soil Map," where broad patterns of soil are described. They may also be interested in the section "Environmental Features."

Cover: Heber Valley, looking southeast from Midway. The irrigated Manila and Rasband soils are in the foreground. The nearly level Kovich soils are on the flood plains. Holmes and Rasband soils are on the distant alluvial fans and stream terraces. Henefer, Gappmayer, and Wallsburg soils are on the lower mountain slopes, and Cluff, Daybell, and Roundy soils are on the higher slopes.

Contents

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1956-62. During 1971 additional work was done to refine the slope groups of soil units mapped at low intensity. Soil names and descriptions were approved in 1971. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1972. This survey was made cooperatively by the Soil Conservation Service and the Forest Service and the Utah Agricultural Experiment Station. It is part of the technical assistance furnished to the Wasatch County Soil Conservation District.

SOIL SURVEY OF THE HEBER VALLEY AREA, UTAH

PARTS OF WASATCH AND UTAH COUNTIES

BY LOWELL WOODWARD, EARL H. JENSEN, AND JOHN L. HARVEY

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE FOREST SERVICE AND THE UTAH AGRICULTURAL EXPERIMENT STATION

THE HEBER VALLEY AREA is in the north-central part of Utah (fig. 1).

The Area includes all of the Wasatch Soil Conservation District, which is approximately the western half of Wasatch County. It also includes about 26,000 acres in Utah County.

The survey area consists of 303,314 acres, about one-sixth of which is Federal land, National Forest, and half of which is irrigated land on the valley floors. The major part is private or State range and woodland. Heber Valley extends about 6 or 7 miles east and west and 2 to 5 miles north and south. Heber is near the center. Round Valley is much smaller, extending about 1 mile north and south and about 5 miles east and west. Wallsburg is near its center. The land surrounding these valleys is mountainous.

Heber, elevation 5,593 feet, is the largest town in the Area. It has a population of about 3,000. Transportation facilities are good. U.S. Highway 40, Denver to Salt Lake City, traverses the Area. Utah Highway 189 intersects U.S. 40 at Heber and leads to Provo, 28 miles to the southwest.

Livestock production is the main enterprise. The mountainous areas are used mainly as summer range for sheep and cattle, the foothill areas for spring-fall range, and the irrigated valleys for pasture, hay, and grain. Recreation and summer home development are becoming increasingly important in the Area.

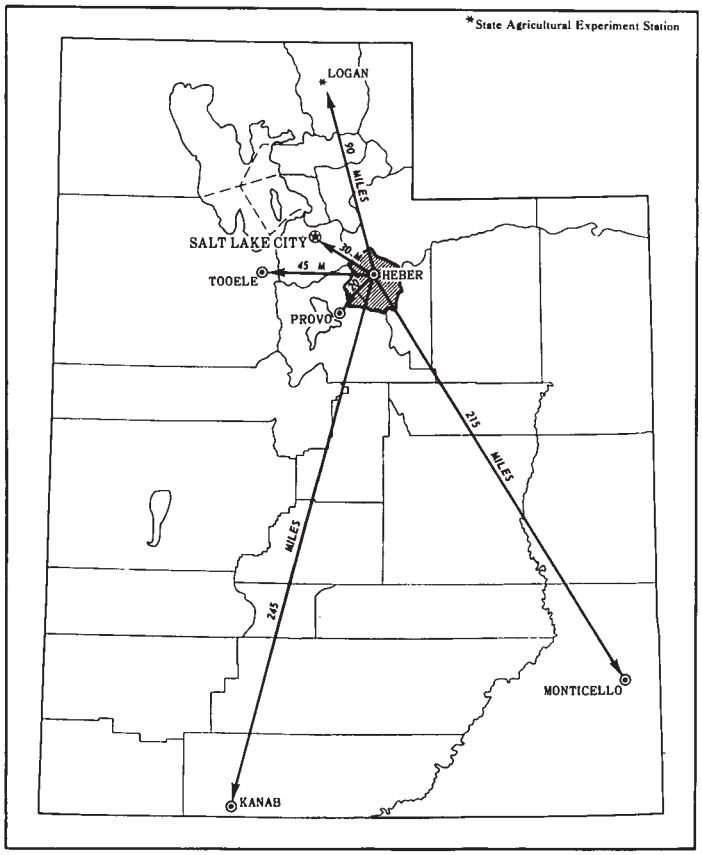

Figure 1.—**Location of the Heber Valley Area in Utah.**

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the Heber Valley Area, where they are located and how they can be used. They went into the area knowing they likely would find some soils they had already seen, and perhaps many they had not. As they traveled over the area, they observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Many soil series are named for a town or other geographic features near the place where the soil was first observed and mapped. Little Pole and Wallsburg, for example, are the names of two soil series. All the soils in the United States that have the same series name are essen-

tially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Clegg loam, 6 to 15 percent slopes, is one of four phases of the Clegg series. Clegg cobbly loam, 5 to 10 percent slopes, is another phase of the Clegg series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show canals, streams, drains, buildings, field borders, trees, roads, and other details that greatly help in drawing boundaries accurately. The soil map in the back of this survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Deer Creek-Watkins Ridge complex, 15 to 25 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Cluff-Daybell association, very steep, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rock land is a land type in the Heber Valley Area.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurement. Laboratory data from the same kinds of soil in other places are assembled. Data on yield of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of the soil survey is done when the soils have been named, described, and delineated on the map and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, engineers, planners, and homeowners.

On the basis of the yield and practice tables and other data, the soil scientists set up trial groups and then test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the result of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The colored general soil map at the back of this survey shows the soil associations in the Heber Valley Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It consists of two or more major soils and generally has one or more minor soils. It is named for two or three of its major soil series. The soils in one association may occur in other associations, but in a different pattern.

The general soil map is useful to users who want a general idea of the soils in an area, who need to compare different parts of the area, or who want to know the location of large tracts suitable for a certain land use. This map is not suitable for planning the management or use of any specific piece of land, because within each association the soils generally differ in slope, depth, texture, drainage, or other characteristics that affect use and management.

The nine soil associations in the Heber Valley Area are described on the pages that follow.

1. Roundy-Daybell association

Well drained and somewhat excessively drained, deep soils formed in residuum and colluvium from mixed sedimentary rocks on high mountainsides and plateaus

This soil association is made up of sloping to very steep soils of the high mountains. It is on plateaus and northerly mountainsides. The elevation ranges from 6,800 to 9,700 feet. The climate is humid and cool. Annual precipitation, mostly snow, is 25 to 35 inches. The average annual air temperature is 35° to 38° F. Average temperature in summer is about 58°.

This association makes up about 17 percent of the survey area. It is about 50 percent Roundy soils, 32 percent Daybell soils, and 18 percent Fitzgerald, Cluff, and Sessions soils.

The sloping and steep Roundy soils are on the plateaus and mountainsides. They are deep, well-drained soils that have a dark grayish-brown loam or cobbly loam surface layer about 24 inches thick, a bleached, pale-brown subsurface layer about 7 inches thick, and a thick reddish-brown and reddish-yellow cobbly clay subsoil that extends to a depth of about 54 inches. The vegetation is mainly aspen, scattered conifers, and a shrub-grass understory.

The steep and very steep Daybell soils are on northerly mountainsides. They are deep, somewhat excessively drained soils that have a very dark grayish-brown loam or gravelly loam surface layer about 16 inches thick over light brownish-gray very gravelly loamy fine sand. The vegetation is mainly aspen,

scattered conifers and maple trees, and a shrub-grass understory.

The steep Fitzgerald soils are under dense conifer patches on northerly exposures. Cluff soils are under mixed conifer and aspen on northerly exposures. Sessions soils are in open grassy parks.

This association is used mainly as summer range for livestock and wildlife. It serves as a catchment area for water and provides sites for recreation and summer homes.

2. *Flygare-Clayburn-Baird Hollow association*

Well-drained, deep soils formed in glacial drift from andesite on high mountainsides and plateaus

This soil association is made up of sloping to very steep soils of the high mountains. It is on plateaus and high mountainsides. The elevation ranges from 6,800 to 9,200 feet. The climate is humid and cool. Annual precipitation, mostly snow, is 25 to 35 inches. The average annual air temperature is 35° to 38° F. Average temperature in summer is about 58° F.

This association makes up about 10 percent of the survey area. It is about 47 percent Flygare soils, 25 percent Clayburn soils, 24 percent Baird Hollow soils, and 4 percent other soils.

The steep Flygare soils are on high mountainsides and high mountain plateaus. They have a dark-brown and brown loam or cobbly loam surface layer about 27 inches thick, a subsurface layer of bleached yellowish-brown very cobbly sandy loam about 9 inches thick, a subsoil of strongly acid, brown and light-brown cobbly sandy clay loam and heavy sandy loam about 14 inches thick, and a very cobbly sandy loam substratum that extends to a depth of 60 inches or more. The vegetation is mainly aspen, scattered spruce and fir, and a grass-shrub understory.

The steep Clayburn soils are mainly on high mountain plateaus, but some are on mountainsides. They have a very dark grayish-brown loam or cobbly loam surface layer about 22 inches thick, a brown sandy clay loam or clay loam subsoil about 18 inches thick, and a gravelly sandy loam substratum that extends to a depth of 60 inches or more. The vegetation is mainly big sagebrush, grasses, and snowberry.

The sloping to very steep Baird Hollow soils are on high mountainsides. They have a very dark grayish-brown loam surface layer about 22 inches thick, a subsurface layer of bleached light brownish-gray cobbly sandy clay loam about 7 inches thick, and a subsoil that is brown cobbly clay loam in the upper part and brown cobbly clay below and extends to a depth of 60 inches or more. The vegetation is mainly aspen, scattered spruce and fir, and a grass-shrub understory.

This association is used mainly as summer range for wildlife and livestock, chiefly sheep. It also serves as a catchment area for water and provides sites for recreation and some summer homes. The dense conifer stands are used mainly for timber.

3. *Hailman-Buell-Lake Janee association*

Well-drained, deep soils formed in glacial drift from quartz-diorite porphyry or in colluvium and alluvium from quartzite on high mountainsides

This soil association is made up of sloping to very steep soils of the high mountains. The elevation ranges from 6,500 to 10,000 feet. The climate is humid and cool. Annual precipitation, mostly snow, is 25 to 35 inches. The average annual air temperature is 38° to 42° F.

This association makes up about 3 percent of the survey area. It is about 52 percent Hailman soils, 25 percent Buell soils, 13 percent Lake Janee soils, and 10 percent other soils.

The moderately steep to very steep Hailman soils are on the southerly exposures of mountainsides. They have a surface layer of very dark grayish-brown and dark grayish-brown loam or cobbly loam about 30 inches thick and a subsoil of yellowish-brown cobbly loam that extends to a depth of 60 inches or more. The vegetation is mainly aspen and an understory of chokecherry, grasses, and snowberry.

Buell soils are on open brush- and grass-covered areas. They have a surface layer of dark grayish-brown very gravelly or gravelly loam about 30 inches thick and a subsoil of pale-brown very gravelly loam that extends to a depth of 60 inches or more. The vegetation is mainly big sagebrush and grasses.

The sloping to steep and rolling Lake Janee soils are on mountainsides. They have a surface layer of dark grayish-brown cobbly sandy loam about 2 inches thick. The subsoil is brown cobbly fine sandy loam and cobbly sandy loam to a depth of about 24 inches and is light yellowish-brown cobbly coarse sandy loam and cobbly sandy loam to a depth of 60 inches or more.

Vegetation is mainly spruce and fir and an understory of red elderberry, elkweed, sedges, and grasses.

This association is used mainly as summer range for livestock, but Lake Janee soils are used mainly for timber. All the soils are used for wildlife habitat and as water catchment and recreation areas and sites for summer homes.

4. *Broadhead-Little Pole association*

Well-drained, deep and shallow soils formed in alluvium, colluvium, or residuum from andesite on mountainsides and alluvial fans

This soil association is made up mainly of sloping to very steep soils on mountainsides and alluvial fans that have a vegetative cover of oakbrush, sagebrush, and grass. The elevation ranges from 6,000 to 8,000 feet. The climate is moist subhumid and cool. The average annual precipitation, mostly snow, is 18 to 25 inches. The average annual air temperature is about 44° F.

This association makes up about 21 percent of the survey area. It is about 45 percent Broadhead soils, 32 percent Little Pole soils, and 23 percent Horrocks and Brad soils, Fluventic Haploborolls, and areas of Rock land.

The sloping to steep Broadhead soils are on mountains. They have a surface layer of dark grayish-brown very cobbly loam, cobbly loam, or loam 5 to 19 inches thick; a subsoil of brown clay and clay loam about 32 inches thick; and a substratum of silt loam that extends to a depth of 60 inches or more. The vegetation is mainly big sagebrush, mixed grasses, and shrubs and patches of dense oakbrush.

The sloping to very steep Little Pole soils are on

ridges and convex slopes. They have a surface layer of very dark grayish-brown and dark grayish-brown very cobbly sandy clay loam 5 to 10 inches thick and a subsoil of grayish-brown cobbly or very cobbly sandy clay loam 4 to 10 inches thick. Andesite bedrock is at a depth of 20 inches or less. The vegetation is mainly snowberry, big sagebrush, and mixed grasses.

The sloping to very steep Horrocks soils are on shrub- and grass-covered mountainsides. The moderately steep to very steep Brad soils are in red sandstone areas. Fluventic Haploborolls are along the stream bottoms.

This association is used mainly as spring and fall range for livestock and wildlife. It is also used for water catchment and recreation areas and some sites for summer homes.

5. *Gappmayer-Henefer-Wallsburg association*

Well-drained, deep and shallow soils formed in alluvium, colluvium, and residuum from mixed sedimentary rocks on mountainsides and alluvial fans

This soil association is made up of steep and very steep soils on mountains and strongly sloping soils on alluvial fans. The elevation ranges from 6,000 to 8,000 feet. The climate is moist subhumid and cool. The average annual precipitation, mostly snow, is 18 to 25 inches. The average annual air temperature is about 44° F.

This association makes up about 30 percent of the survey area. It is about 25 percent Gappmayer soils, 24 percent Henefer soils, 19 percent Wallsburg soils, and 32 percent other soils and areas of Rock land.

Gappmayer soils are on mountainsides. They have a surface layer of dark grayish-brown gravelly or very cobbly very fine sandy loam 8 to 19 inches thick and a subsurface layer of brown and pale-brown bleached cobbly fine sandy loam. The subsoil is reddish-brown very cobbly sandy clay loam that extends to a depth of 40 inches or more. The vegetation is mainly oakbrush and big sagebrush and some maple, snowberry, and grasses.

The sloping to steep Henefer soils (fig. 2) are on alluvial fans and mountainsides. They have a surface layer of dark grayish-brown silt loam or cobbly silt loam 6 to 19 inches thick, a subsoil of brown cobbly clay 21 to 32 inches thick, and a substratum of cobbly

Figure 2.—**Valley bottom. The poorly drained Cudahy cold variant is in the foreground. The well-drained Henefer soils are on the alluvial fans and foothills.**

or very cobbly clay loam that extends to a depth of 60 inches or more. The vegetation is mainly oakbrush, big sagebrush, other shrubs, and such mixed grasses as bluebunch wheatgrass.

The steep and very steep Wallsburg soils are on rocky southerly mountainsides. They have a surface layer of dark grayish-brown very cobbly sandy clay loam 5 to 11 inches thick and a subsoil of brown very cobbly heavy clay loam 2 to 9 inches thick. Fractured bedrock is at a depth of 20 inches or less. The vegetation is mainly big sagebrush, birchleaf mountainmahogany, and such grasses as bluebunch wheatgrass.

The very steep Bradshaw soils are on brushy mountainsides. The steep and very steep Burgi soils are on northerly exposures of oakbrush-covered slopes. The sloping to steep Bezzant soils are on the grass- and browse-covered lower mountainsides. The shallow Agassiz soils are on browse covered limestone ridges.

This association is used mainly for spring and fall grazing of livestock and wildlife and as water catchment and recreation areas.

6. Van Wagoner-Cloud Rim-McPhie association

Well-drained, shallow and deep soils formed in residuum and glacial drift from quartz-diorite porphyry and in alluvium and colluvium from mixed sedimentary rocks on mountainsides, alluvial fans, colluvial cones, and terminal moraines

This soil association is made up of steep and very steep soils of the mountains. The elevation ranges from 6,300 to 7,000 feet. The climate is moist subhumid and cool. Annual precipitation, mostly snow, is 18 to 25 inches. The average air temperature is 42° to 47° F.

This association makes up about 3 percent of the survey area. It is about 40 percent Van Wagoner soils, 33 percent Cloud Rim soils, 14 percent McPhie soils, and 13 percent areas of Rock land.

The Van Wagoner soils are on the northerly exposures of mountainsides. They have a surface layer of dark grayish-brown cobbly sandy loam 7 to 16 inches thick and a substratum of grayish-brown very cobbly sandy loam. Bedrock is at a depth of 10 to 20 inches. The vegetation is mainly oakbrush, curlleaf mountainmahogany, sagebrush, and grasses.

The Cloud Rim soils are on southerly mountainsides, alluvial fans, and colluvial cones of the mountains. They have a surface layer of grayish-brown loam 10 to 15 inches thick and a subsoil of light-brown heavy loam and loam that extends to a depth of 60 inches or more. The vegetation is mainly oakbrush, big sagebrush, and grasses.

The McPhie soils are on easterly exposures of terminal moraines of the mountains. They have a surface layer of very dark grayish-brown fine sandy loam 10 to 13 inches thick; a subsurface layer of bleached, pale-brown fine sandy loam 10 to 15 inches thick; and a subsoil of light yellowish-brown cobbly fine sandy loam about 36 inches thick. The underlying material is pale-brown very cobbly loamy sand to a depth of 60 inches or more. The vegetation is mainly oakbrush and grasses, scattered maple, and Douglas-fir.

The areas of Rock land consist of rock outcrops and areas that have less than 4 inches of soil mantle.

This association is used mainly as spring and fall range for livestock and wildlife, water catchment areas, and some recreation areas.

7. Yeates Hollow-Watkins Ridge-Deer Creek association

Well-drained, deep soils formed in alluvium and residuum from mixed sedimentary rocks on foothills, mountain foot slopes, and alluvial fans

This soil association is made up of soils of the foothills and alluvial fans. The elevation ranges from 5,400 to 6,000 feet. The climate is moist subhumid and cool. Annual precipitation, mostly snow, is 16 to 18 inches. The average annual air temperature is about 45° F.

This association makes up about 9 percent of the survey area. It is about 30 percent Yeates Hollow soils, 21 percent Watkins Ridge soils, 17 percent Deer Creek soils, 11 percent Clegg soils, and 21 percent other soils and areas of Rock land.

Yeates Hollow soils are on the alluvial fans of the mountain foothills. They have a surface layer of dark grayish-brown loam or very cobbly loam 8 to 13 inches thick and a subsoil of reddish-brown very cobbly sandy clay or clay that extends to a depth of 60 inches or more. The vegetation is mainly oakbrush, big sagebrush, bitterbrush, and grasses.

The Watkins Ridge soils are on alluvial fans and ridges of the lower mountains. They have a surface layer of dark grayish-brown silt loam 7 to 13 inches thick. The substratum is strongly calcareous, pale-brown loam and clay loam to a depth of 60 inches or more. The vegetation is mainly big sagebrush, bitterbrush, oakbrush, and grasses.

The Deer Creek soils are on alluvial fans and lower mountainsides. They have a surface layer of dark grayish-brown loam 7 to 14 inches thick. The subsoil is reddish-brown gravelly clay 14 to 30 inches thick, and the substratum is very pale brown or white, strongly calcareous gravelly or cobbly clay loam to a depth of 60 inches or more. The vegetation is mainly oakbrush, big sagebrush, bitterbrush, and grasses.

Clegg soils are mainly on alluvial fans of the mountain foothills. They have a surface layer of dark grayish-brown loam 8 to 15 inches thick and a subsoil of dark-brown heavy loam 15 to 23 inches thick. The substratum is strongly calcareous, very pale brown loam to a depth of 60 inches or more. The vegetation is mainly big sagebrush, bitterbrush, and mixed grasses. The sloping and moderately steep Manila soils are on alluvial fans, most of which are in cultivated crops. The strongly sloping Henefer soils are on alluvial fans used mostly for irrigated pasture. The Rasband soils are on alluvial fans.

This association is used mainly as spring and fall range for livestock and wildlife, but many of the less steep areas are used for irrigated crops and pasture. Water catchment and recreation are other uses.

8. Holmes-Rasband association

Well drained and somewhat poorly drained, deep soils formed in mixed alluvium on alluvial fans and stream terraces

This soil association is made up mainly of soils on alluvial fans and stream terraces of the valleys. The elevation ranges from 5,500 to 6,200 feet. The climate is moist subhumid and cool. Annual precipitation, mostly snow, is 16 to 18 inches. The average annual air temperature is about 47° F.

This association makes up about 4 percent of the survey area. It is about 45 percent Holmes soils, 31 percent Rasband soils, 10 percent Center Creek soils, 10 percent Kovich deep water table variant, and 4 percent Steed cold variant.

Holmes soils are on alluvial fans and stream terraces. They have a surface layer of brown gravelly loam 6 to 15 inches thick. The subsoil is brown very gravelly loam in the upper 10 inches and yellowish-brown very gravelly coarse sandy loam in the lower 7 inches. The substratum is yellowish-brown loamy coarse sand to a depth of 60 inches or more. The vegetation is mainly alfalfa, small grain, and pasture in the irrigated areas and big sagebrush, native bluegrass, and junegrass in the nonirrigated areas.

The Rasband soils are on alluvial fans and stream terraces. They have a surface layer of dark grayish-brown loam 5 to 7 inches thick and a subsoil of dark grayish-brown loam 11 to 36 inches thick. The substratum is brown very gravelly coarse sand to a depth of 60 inches or more. The vegetation is mainly hay, grain, and pasture where irrigated and big sagebrush, bitterbrush, and grasses in nonirrigated areas.

The Center Creek soils are on stream terraces. They have a surface layer of dark-gray loam 12 to 20 inches thick and a subsoil of grayish-brown clay loam 13 to 33 inches thick. The substratum is very gravelly and ranges in texture from coarse sandy loam to sandy clay loam. It extends to a depth of 60 inches or more. The vegetation is mainly hawthorn, willow, and cottonwood in the nonirrigated areas and native meadow, small grain, and some alfalfa in the irrigated areas.

The Kovich deep water table variant is on terraces near streams. It is loam or silt loam to a depth of 39 inches. Colors are very dark grayish brown in the upper part and dark grayish brown in the lower part. Below about 40 inches is grayish-brown loam that is gravelly or cobbly. Mottling occurs at a depth of 30 to 40 inches. The vegetation is mainly irrigated crops and pasture. Big sagebrush, oakbrush, and grasses are in nonirrigated areas.

The Steed cold variant is on flood plains and alluvial fans in the irrigated valleys.

This association is used mainly for irrigated pasture and crops. Range pasture, wildlife, and town sites are the other uses.

9. Kovich-Fluventic Haploborolls-Crooked Creek association

Moderately well drained and poorly drained, deep soils formed in mixed alluvium on flood plains, low stream terraces, and valley bottoms

This soil association is made up of soils of the flood plains and low stream terraces. The elevation ranges from 5,200 to 6,000 feet. The climate is moist subhumid and cool. Annual precipitation, mostly snow, is 16 to 18 inches. The average air temperature is about 45° F.

This association makes up about 3 percent of the survey area. It is about 28 percent Kovich soils, 21 percent Fluventic Haploborolls, 14 percent Crooked Creek soils, 17 percent Kovich gravelly subsoil variant and Logan cold variant, and 20 percent other soils and land types.

The Kovich soils are on the wet flood plain and low stream terraces. They have a surface layer of very dark grayish-brown and grayish-brown loam 24 to 40 inches thick that is mottled below a depth of about 11 inches. The substratum is very dark grayish-brown very cobbly sandy clay loam to a depth of about 40 inches underlain by very gravelly sand to a depth of 60 inches or more. The vegetation is mainly sedges, wiregrass, bluegrass, timothy, and clover.

The Fluventic Haploborolls are the intermixed soils along the stream bottoms of the valleys. They have a loamy surface layer 6 to 15 inches thick that is underlain by loose gravel. Textures and depths vary significantly within very short distances. In many places the surface layer is cobbly or gravelly. Abandoned stream channels normally dissect the landscape. The vegetation is mainly cottonwood, willow, and hawthorn and an understory of grass and browse. Some areas are irrigated for pasture.

The Crooked Creek soils are mainly on low stream terraces adjacent to streams. They have a surface layer of dark grayish-brown clay loam 7 to 12 inches thick. The substratum is dark-gray or grayish-brown clay loam and silty clay to a depth of 30 to 40 inches. Below this, the substratum is mottled olive-brown clay loam to a depth of 60 inches or more. The vegetation is mainly sedges, wiregrass, timothy, and tules.

The Kovich gravelly subsoil variant and Logan cold variant are wet soils on low stream terraces. The Kovich deep water table variant is a moderately wet soil on stream terraces.

The Spaa soils and Cudahy cold variant are shallow over travertine and are indurated hardpan. Rock land, travertine, is barren or nearly barren rock. These soils and land types are on the travertine benches or terraces near Midway.

This soil association is used mainly for native pasture, meadow hay, and wildlife.

Descriptions of the Soils

This section describes the soil series, which are groups of similar soils, and the mapping units of the Heber Valley Area. The acreage and proportionate extent of each mapping unit are given in table 1.

The procedure in this section is first to describe the soil series and then the mapping units in the series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. Not all mapping units are members of a soil series. Fluventic Haploborolls and Rock land are miscellaneous land types and do not belong to a soil series; nevertheless, they are listed in alphabetic order along with the series.

TABLE 1.—*Approximate acreage and proportionate extent of soils*

Soil	Area	Extent
	Acres	*Percent*
Agassiz very cobbly loam, 25 to 60 percent slopes	446	0.1
Agassiz-Wallsburg association, very steep	608	.2
Baird Hollow loam, 6 to 15 percent slopes	2,983	1.0
Baird Hollow loam, 15 to 25 percent slopes	2,232	.7
Baird Hollow loam, 25 to 40 percent slopes	1,424	.4
Baird Hollow loam, 40 to 60 percent slopes	327	.1
Baird Hollow-Flygare association, moderately steep	336	.1
Baird Hollow-Flygare association, steep	486	.1
Baird Hollow association, moderately steep	1,058	.3
Bezzant cobbly loam, 10 to 20 percent slopes, eroded	232	.1
Bezzant very cobbly loam, 6 to 10 percent slopes	338	.1
Bezzant very cobbly loam, 15 to 45 percent slopes	1,952	.6
Brad-Rock outcrop complex, 15 to 65 percent slopes	2,992	1.0
Bradshaw very cobbly very fine sandy loam, 40 to 60 percent slopes	1,435	.5
Bradshaw-Henefer association, very steep	336	.1
Bradshaw-Wallsburg association, very steep	4,675	1.5
Broadhead very cobbly loam, 15 to 40 percent slopes	1,640	.5
Broadhead-Little Pole association, moderately steep	648	.2
Broadhead-Little Pole association, hilly	1,710	.5
Broadhead-Little Pole association, steep	12,788	4.9
Broadhead-Little Pole association, very steep	9,192	3.0
Broadhead soils, 6 to 15 percent slopes	3,261	1.1
Broadhead soils, 15 to 25 percent slopes	3,453	1.0
Broadhead soils, 25 to 40 percent slopes	1,916	.6
Broadhead soils, 40 to 60 percent slopes	448	.1
Buell gravelly loam, 6 to 15 percent slopes	224	.1
Buell gravelly loam, 15 to 25 percent slopes	432	.1
Buell gravelly loam, 25 to 60 percent slopes	1,788	.6
Burgi gravelly loam, 25 to 40 percent slopes	1,488	.5
Burgi gravelly loam, 40 to 60 percent slopes	2,854	.9
Burgi-Agassiz association, very steep	576	.2
Burgi-Wallsburg association, very steep	1,616	.5
Center Creek loam	1,193	.4
Clayburn loam, 3 to 6 percent slopes	404	.1
Clayburn loam, 6 to 15 percent slopes	2,650	.9
Clayburn loam, 15 to 25 percent slopes	3,090	1.0
Clayburn-Flygare association, hilly	1,288	.4
Clayburn soils, 25 to 40 percent slopes	987	.3
Clegg loam, 1 to 3 percent slopes	614	.2
Clegg loam, 3 to 6 percent slopes	840	.3
Clegg loam, 6 to 15 percent slopes	949	.3
Clegg cobbly loam, 5 to 10 percent slopes	231	.1
Cloud Rim loam, 10 to 25 percent slopes	208	
Cloud Rim loam, 25 to 40 percent slopes	260	.1
Cloud Rim soils, 40 to 60 percent slopes	2,185	.7
Cluff-Daybell association, very steep	317	.1
Cluff soils, 6 to 15 percent slopes	333	.1
Cluff soils, 15 to 25 percent slopes	557	.2
Cluff soils, 40 to 60 percent slopes	534	.2
Crooked Creek clay loam, 1 to 3 percent slopes	1,275	.4
Crooked Creek clay loam, 3 to 10 percent slopes	189	
Cudahy silt loam, cold variant	369	.1
Cudahy silt loam, cold variant, moderately deep water table	237	.1
Daybell-Fitzgerald association, very steep	8,848	2.9
Daybell soils, 25 to 40 percent slopes	608	.2
Daybell soils, 40 to 65 percent slopes	8,911	2.9
Deer Creek loam, 1 to 3 percent slopes	539	.2
Deer Creek loam, 3 to 10 percent slopes	456	.2
Deer Creek-Watkins Ridge complex, 6 to 15 percent slopes	846	.3
Deer Creek-Watkins Ridge complex, 15 to 25 percent slopes	3,286	1.1
Fluventic Haploborolls	4,678	1.5
Flygare loam, 3 to 6 percent slopes	400	.1
Flygare loam, 6 to 15 percent slopes	2,530	.8
Flygare loam, 15 to 25 percent slopes	1,594	.5
Flygare-Little Pole association, hilly	2,168	.7
Flygare-Little Pole association, steep	1,271	.4
Flygare soils, 25 to 40 percent slopes	4,949	1.6
Flygare soils, 40 to 60 percent slopes	2,084	.7
Flygare soils, sandy loam subsoil variant, 25 to 40 percent slopes	908	.3
Gappmayer gravelly fine sandy loam, 15 to 25 percent slopes	309	.2
Gappmayer gravelly fine sandy loam, 40 to 65 percent slopes	6,051	2.0
Gappmayer very cobbly fine sandy loam, 40 to 65 percent slopes	2,806	0.9
Gappmayer-Bradshaw association, very steep	5,636	1.9
Gappmayer-Wallsburg association, very steep	11,380	3.7
Hailman loam, 6 to 15 percent slopes	464	.2
Hailman loam, 15 to 30 percent slopes	1,472	.5
Hailman soils, 40 to 60 percent slopes	3,124	1.0
Henefer silt loam, 1 to 3 percent slopes	282	1
Henefer silt loam, 6 to 10 percent slopes	192	
Henefer silt loam, 10 to 25 percent slopes	259	.1
Henefer-Bradshaw association, very steep	2,036	.7
Henefer-Gappmayer association, very steep	3,056	1.0
Henefer-Wallsburg association, very steep	1,336	.4
Henefer soils, 6 to 10 percent slopes	4,157	1.3
Henefer soils, 10 to 25 percent slopes	4,785	1.6
Henefer soils, 25 to 50 percent slopes	7,639	2.6
Holmes cobbly sandy loam	884	.3
Holmes cobbly sandy loam, channeled	388	.1
Holmes very cobbly sandy loam	203	
Holmes gravelly loam	3,916	1.3
Horrocks-Broadhead association, moderately steep	296	.1
Horrocks-Broadhead association, steep	2,884	1.0
Horrocks-Broadhead association, very steep	3,209	1.0
Kovich loam	1,277	.4
Kovich loam, channeled	926	.3
Kovich loam, moderately deep water table	707	.2
Kovich loam, deep water table variant	1,491	.5
Kovich loam, gravelly subsoil variant	398	.1
Kovich loam, gravelly subsoil variant, channeled	194	
Kovich loam, gravelly subsoil variant, moderately deep water table	302	.1
Lake Janee soils, 15 to 40 percent slopes	1,262	.4
Little Pole very cobbly sandy clay loam, 6 to 25 percent slopes	4,458	1.4
Little Pole very cobbly sandy clay loam, 40 to 60 percent slopes	6,388	2.0
Logan silty clay, cold variant	517	.1
Manila silt loam, 3 to 6 percent slopes	485	.2
Manila silt loam, 6 to 10 percent slopes	394	.1
Manila silt loam, 10 to 20 percent slopes	513	.1
McPhie fine sandy loam, 40 to 60 percent slopes	592	.2
McPhie-Henefer association, very steep	528	.2
Mult soils, thick solum variant, 5 to 25 percent slopes	1,262	.4
Mult clay loam, thick solum variant, 25 to 40 percent slopes	560	.2
Poleline soils, 40 to 70 percent slopes	872	.3
Rasband coarse sandy loam, 3 to 6 percent slopes	353	.1
Rasband coarse sandy loam, 6 to 15 percent slopes	603	.2
Rasband loam, 1 to 3 percent slopes	2,158	.7
Rasband loam, 3 to 10 percent slopes	362	.1
Rock land	18,511	6.8

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of soils*—Continued

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Rock land, travertine	841	0.3	Watkins Ridge-Clegg complex, 6 to 15 percent slopes	4,480	1.5
Roundy loam, 5 to 15 percent slopes	1,507	.5	Watkins Ridge-Clegg complex, 15 to 25 percent slopes	768	.3
Roundy loam, 15 to 25 percent slopes	2,164	.7	Watkins Ridge-Deer Creek complex, 6 to 15 percent slopes	392	.1
Roundy loam, 25 to 40 percent slopes	8,322	2.8	Watkins Ridge-Deer Creek complex, 15 to 25 percent slopes	2,392	.8
Roundy loam, 40 to 60 percent slopes	3,880	1.3	Whipstock very cobbly loam, 15 to 60 percent slopes	1,168	0.4
Roundy-Cluff association, moderately steep	2,761	.9	Whipstock soils, 6 to 15 percent slopes	245	.1
Roundy-Cluff association, hilly	5,608	1.9	Whipstock soils, 15 to 25 percent slopes	218	.1
Roundy-Daybell association, very steep	4,178	1.4	Whipstock soils, 25 to 40 percent slopes	336	.1
Roundy soils, 15 to 25 percent slopes	563	.2	Yeates Hollow loam, 2 to 5 percent slopes	414	.1
Sessions clay loam, 5 to 15 percent slopes	938	.3	Yeates Hollow very cobbly loam, 6 to 15 percent slopes	200	(1)
Sessions clay loam, 15 to 25 percent slopes	994	.3	Yeates Hollow very cobbly loam, 15 to 25 percent slopes	2,468	.8
Spaa silt loam, 2 to 5 percent slopes	622	.2	Yeates Hollow-Henefer association, moderately steep	749	.3
Steed loam, cold variant	300	.1	Yeates Hollow-Henefer association, hilly	259	.1
Steed cobbly loam, cold variant	207		Total	303,314	100.0
Van Wagoner-McPhie association, very steep	672	.2			
Van Wagoner-Rock outcrop complex, 40 to 70 percent slopes	2,688	.9			
Wallsburg-Rock outcrop complex, 20 to 60 percent slopes	10,760	3.5			
Watkins Ridge silt loam, 6 to 15 percent slopes	1,208	.4			
Watkins Ridge silt loam, 15 to 25 percent slopes	455	.2			

[1] Less than 0.05 percent.

The mapping units in this survey are not all mapped with equal intensity or degree of precision. Mapping units in parts of the survey area that are cultivated, or mostly cultivated, contain less than 20 percent of soils other than those shown in the name of the unit. In the tracts not cultivated, mapping units are less precise.

Unless stated otherwise, the colors shown in this section are those of a dry soil. Color designations are those of the Munsell system (*7*).[1]

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit, range site, and wildlife group to which the mapping unit has been assigned. The page on which each capability unit and range site is described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Soil scientists, engineers, students, and others interested in the origin and classification of the soils should turn to the section "Formation and Classification of the Soils." Many terms used in the soil descriptions and other sections are defined in the Glossary and in the "Soil Survey Manual" (*7*).

Agassiz Series

The Agassiz series consists of somewhat excessively drained, shallow soils. These soils formed on mountainsides in residuum and colluvium derived mainly from mixed sedimentary rocks. Slopes are 25 to 60 percent. The elevation ranges from 5,500 feet to 7,500 feet. The vegetation is mainly birchleaf mountainmahogany, bitterbrush, and grasses. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is about 43° F., and the frost-free period is 50 to 70 days.

In a representative profile the surface layer is grayish-brown and brown very cobbly loam and very cobbly heavy loam about 13 inches thick. It is underlain by weathered limestone and dolomite bedrock. The soil is moderately or mildly alkaline.

Representative profile of Agassiz very cobbly loam, 25 to 60 percent slopes, 3/8 mile west of the north end of Deer Creek Dam, 2,360 feet west and 400 feet north of southeast corner of sec. 6, T. 5 S., R. 4 E. in an area of range:

All—0 to 6 inches, grayish-brown (10YR 5/2) very cobbly loam, very dark grayish brown (10YR 3/2) moist; weak, thick, platy structure parting to weak, medium, granular; soft, friable, slightly sticky and slightly plastic; common fine and medium roots; many medium vesicular pores; 60 percent gravel, cobbles, and stones; slightly calcareous; moderately alkaline; clear, wavy boundary.

A12—6 to 13 inches, brown (10YR 5/3) very cobbly heavy loam, dark brown (10YR 3/3) moist; very weak, medium, subangular blocky structure parting to strong, medium, granular; slightly hard, friable, sticky and plastic; plentiful fine and medium roots; 60 percent gravel, cobbles, and stones; slightly calcareous; mildly alkaline; abrupt, irregular boundary.

R—13 inches, weathered limestone and dolomite.

The soil is 9 to 20 inches deep over bedrock. The All horizon has color value of 4 or 5 when dry and 1 to 3 when moist and has chroma of 2 or 3. It is very cobbly loam or heavy loam and is 2 to 6 inches thick. The A12 horizon has color value of 4 to 6 when dry and 2 or 3 when moist and has chroma of 2 or 3. Value of 6 may occur below a depth of 7 inches. The A12 horizon is 7 to 14 inches thick, ranges from very cobbly loam to very cobbly clay loam, and is 50 to 70 percent rock fragments.

Agassiz soils are moderately permeable. Available water capacity is about 1 to 2 inches, depending on the depth to bedrock. The water-supplying capacity is

[1] Italic numbers in parentheses refer to Literature Cited, p. 122.

3 to 6 inches before stored moisture is depleted. The depth to which roots can penetrate is less than 20 inches except where bedrock is fractured.

These soils are used as range for livestock and wildlife and as watershed and sites for recreation.

Agassiz very cobbly loam, 25 to 60 percent slopes (AGF).—This soil is mainly on southerly exposures of steep mountainsides. It has the profile described as representative of the series. Runoff is rapid, and the hazard of water erosion is moderate to high.

Included with this soil in mapping are areas of Bradshaw and Wallsburg soils and scattered Rock outcrop.

This Agassiz soil is used mainly as range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIIs-M nonirrigated; Mountain Shallow Loam range site; wildlife group 4343.

Agassiz-Wallsburg association, very steep (AWF).—This mapping unit is on southerly exposures of very steep mountainsides. It is about 50 percent Agassiz very cobbly loam, 25 to 60 percent slopes; 35 percent Wallsburg very cobbly sandy clay loam, 20 to 60 percent slopes; and about 15 percent other soils and Rock outcrop. Runoff is rapid, and the erosion hazard is moderate to high.

Included in this mapping unit are small areas of Bradshaw soils, which are associated with the Agassiz soil. Also included are areas of Rock outcrop and Rock land where the soil material is less than 4 inches thick.

This mapping unit is used mainly as range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIIs-M nonirrigated; Mountain Shallow Loam range site; wildlife group 4343.

Baird Hollow Series

The Baird Hollow series consists of well-drained, deep cobbly soils. These soils formed on mountainsides in glacial drift derived mainly from andesite rocks. Slopes are 6 to 60 percent. The elevation ranges from 7,500 to 9,000 feet. The vegetation is mainly aspen, scattered Alpine fir, Douglas-fir, and Engelmann spruce, and an understory of snowberry, red elderberry, mountain bromegrass, and other grasses and forbs. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 40° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is very dark grayish-brown loam and cobbly light clay loam about 22 inches thick. The subsurface layer is light brownish-gray cobbly sandy clay loam about 7 inches thick. The subsoil is brown cobbly clay loam to a depth of 38 inches. Below this, it is brown cobbly clay to a depth of 72 inches. The soil is slightly to medium acid in the upper 29 inches and strongly acid below.

Representative profile of Baird Hollow loam, 6 to 15 percent slopes, 13.5 miles east from the center of Heber City on the Lake Creek Road at a point 2,600 feet west and 1,200 feet south of the northeast corner of sec. 24, T. 4 S., R. 6 E. in grazable woodland. Laboratory data available.

O1—1 inch to 0, aspen leaves, twigs, and other forest duff.

A11—0 to 5 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; slightly acid; clear, wavy boundary.

A12—5 to 22 inches, very dark grayish-brown (10YR 3/2) cobbly light clay loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, very friable, sticky and plastic; many, fine and common medium roots; many fine pores; 20 percent cobbles and stones; medium acid; abrupt, wavy boundary.

A&B—22 to 29 inches. The A2 part is light brownish-gray (10YR 6/2) cobbly sandy clay loam, dark grayish-brown (10YR 4/2) moist; the B2 part is brown (10YR 5/3) cobbly sandy clay loam, dark brown (10YR 4/3) moist. Peds are mainly A2 material with B2 interiors; weak, coarse and medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; 50 percent cobbles and stones; medium acid; clear, irregular boundary.

B21t—29 to 38 inches, brown (7.5YR 5/3) cobbly clay loam, dark brown (7.5YR 4/3) moist; moderate, coarse, subangular blocky structure parting to strong, medium, angular blocky; very hard, very firm, sticky and plastic; common fine roots; few very fine pores; moderately thick continuous clay films; thin patchy gray coatings; 50 percent cobbles and stones; strongly acid; gradual, wavy boundary.

B22t—38 to 55 inches, brown (7.5YR 5/3) cobbly clay, dark brown (7.5YR 3/3) moist; moderate, coarse, subangular blocky structure parting to strong, medium, angular blocky; very hard, very firm, very sticky and very plastic; few fine roots; few fine pores; moderately thick continuous clay films; 50 percent cobbles and stones; very strongly acid; gradual, wavy boundary.

B23t—55 to 72 inches, brown (7.5YR 5/3) cobbly clay, dark brown (7.5YR 4/3) moist; moderate, coarse, subangular blocky structure parting to strong, medium, subangular blocky; very hard, very firm, sticky and plastic; few fine roots; few fine pores; thin continuous clay films; 50 percent cobbles and stones; very strongly acid.

The A1 horizon has color value of 2 or 3 when dry and 1 or 2 when moist. It is 10 to 26 inches thick. The A&B horizon has color value of 5 or 6 when dry and 3 or 4 when moist and has chroma of 2 or 3. This horizon is 5 to 20 inches thick. It ranges from loam to heavy clay loam, and the content of gravel, cobbles, and stones ranges from few to 40 percent. The B2 horizon has hue of 7.5YR to 10YR; value of 3 or 4 when moist; and chroma of 3 or 4. It ranges from clay loam to clay and is 35 to 50 percent gravel, cobbles, and stones.

Baird Hollow soils are slowly permeable. The available water capacity is about 6 inches. The water-supplying capacity is 15 to 17 inches before stored moisture is depleted. Roots can penetrate to a depth of 72 inches or more.

These soils are used as summer range for livestock and wildlife. They also serve as a catchment area for water and provide sites for recreation and summer homes.

Baird Hollow loam, 6 to 15 percent slopes (BAC).—This soil is mainly on ground and lateral moraines of north-facing mountainsides. It has the profile described as representative of the series. Runoff is slow, and the erosion hazard is slight.

Included with this soil in mapping are small tracts of Baird Hollow loam, 15 to 25 percent slopes; Baird Hollow soils that have slopes of less than 6 percent; and Flygare loam, cobbly loam, and very cobbly loam, 6 to 15 percent slopes. Also included are soils that have a cobbly loam surface layer and soils under a spruce-fir overstory that have a dark-colored surface layer 6 to 9 inches thick.

This Baird Hollow soil is used mainly as summer range for livestock and deer. It is important as a catchment area for water, and it also provides sites for recreation and summer homes. A small acreage is woodland. Capability unit VIe-H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Baird Hollow loam, 15 to 25 percent slopes (BAD).—This soil is mainly on ground and lateral moraines of northerly mountainsides. Runoff is slow, and the erosion hazard is slight.

Included with this soil in mapping are small areas of less sloping Baird Hollow soils, some of which have slopes of less than 6 percent, and small areas of Flygare loam, cobbly loam, and very cobbly loam. Also included are small areas of soils, under a spruce-fir overstory, that have a dark-colored surface layer 6 to 9 inches thick.

This Baird Hollow soil is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. A small acreage is woodland. Capability unit VIe-H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Baird Hollow loam, 25 to 40 percent slopes (BAE).—This soil is mainly on ground moraines that mantle steep northerly mountainsides. Runoff is medium, and the erosion hazard is moderate.

Included with this soil in mapping are small areas of soil that have a very cobbly loam surface layer and soils, under small conifer patches, that have a more pronounced subsurface layer.

This soil is used mainly as summer range for livestock and wildlife. It is also important as a catchment area for water and it is used to some extent for recreation and woodland. Capability unit VIe-H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Baird Hollow loam, 40 to 60 percent slopes (BAF).—This soil is mainly on northerly exposures of very steep mountainsides. Runoff is rapid, and the erosion hazard is high.

Included with this soil in mapping are soils that have a cobbly loam surface layer and soils, under small conifer patches, that have a more pronounced subsurface layer.

This soil is used mainly as summer range for livestock and wildlife. It is also important as a catchment area for water, and it is used to some extent for recreation and woodland. Capability unit VIIe-H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Baird Hollow-Flygare association, moderately steep (BCC).—This mapping unit is mainly on hummocky, undulating to rolling glacial moraines in mountainous areas. It is about 50 percent Baird Hollow loam, 35 percent Flygare very cobbly loam, and 15 percent other soils and Rock outcrop. The Baird Hollow soil is mostly in depressions between the hummocks. The Flygare soil is mainly on the hummocks. It has a profile similar to the one described as representative of the Flygare series, but the surface layer is 50 to 70 percent cobbles. Runoff is slow, and the erosion hazard is slight.

Included in this mapping unit are interspersed small areas of similar soils where slopes are more than 15 percent and areas where they are less than 6 percent.

This mapping unit is used mainly as summer range for livestock and wildlife. It is also important as a catchment area for water, and it provides sites for summer homes and recreation. Some areas can be used to a limited extent for woodland. Wildlife group 3141; Baird Hollow soil in capability unit VIe-H nonirrigated, High Mountain Loam (Aspen) range site; Flygare soil in capability unit VIIs-H nonirrigated, High Mountain Stony Loam (Aspen) range site.

Baird Hollow-Flygare association, steep (BCE).—This mapping unit is on hummocky, rolling to steep ground and terminal moraines on mountainsides. It is about 50 percent Baird Hollow loam, 15 to 25 percent slopes; 35 percent Flygare very cobbly loam, 15 to 40 percent slopes; and 15 percent other soils and Rock outcrop. The Baird Hollow soil is in the depressed areas between hummocks. The Flygare soil is on the hummocks and ridges. It has a profile similar to the one described as representative of the Flygare series, but the surface area is 50 to 70 percent cobbles. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Included in the mapping unit are areas of similar soils where slopes are less than 15 percent.

This mapping unit is used mainly as summer range for livestock and wildlife. It is also important as a catchment area for water. Some areas are used for recreation, and a small acreage is woodland. Wildlife group 3141; Baird Hollow soil in capability unit VIe-H nonirrigated, High Mountain Loam (Aspen) range site; Flygare soil in capability unit VIIs-H nonirrigated, High Mountain Stony Loam (Aspen) range site.

Baird Hollow association, moderately steep (BDC).—This mapping unit is on northerly exposures of glaciated hummocky to rolling mountainsides where the overstory is intermingled areas of aspen and conifer trees. It is about 50 percent Baird Hollow loam; 20 percent Flygare coarse sandy loam, sandy loam subsoil variant; 15 percent Flygare cobbly coarse sandy loam, sandy loam subsoil variant; and 15 percent other soils. The Baird Hollow soil is under the aspen. The Flygare sandy loam subsoil variants have a spruce-fir overstory. The Flygare cobbly coarse sandy loam has a profile similar to the one described as representative of the Flygare series, but the surface layer is 20 to 50 percent cobbles. Runoff is slow, and the hazard of erosion is slight. Soil blowing is not a hazard.

Included in this mapping unit are interspersed small tracts where slopes are more than 15 percent and tracts where they are less than 6 percent.

This mapping unit is used mainly as summer range for livestock and wildlife. It is also important as a catchment area for water. Some sites are used for summer homes, recreation, and woodland. Wildlife group 3141; Baird Hollow soil in capability unit VIe-H nonirrigated, High Mountain Loam (Aspen) range site; Flygare variant soils in capability unit VIe-HC nonirrigated, woodland.

Bezzant Series

The Bezzant series consists of well-drained, very cobbly soils. These soils formed on mountainsides in alluvium, colluvium, and residuum derived from mixed sedimentary rocks. Slopes range from 6 to 45 percent. The elevation ranges from 5,500 to 6,000 feet. The vegetation is mainly big sagebrush, serviceberry, bitterbrush, Indian ricegrass, native bluegrasses, wheatgrasses, and balsamroot. The average annual precipitation is 16 to 18 inches, the mean annual air temperature is about 44 ° F., and the frost-free period is 70 to 90 days.

In a representative profile the surface layer is dark grayish-brown cobbly loam and very cobbly loam about 16 inches thick. The next layer is dark grayish-brown very cobbly loam about 6 inches thick. The substratum, to a depth of about 25 inches, is grayish-brown very cobbly clay loam. Below this, it is white very cobbly sandy clay loam to a depth of 60 inches. The soil is mildly alkaline to neutral.

Bezzant soils are moderately slowly permeable. Available water capacity is about 4 inches. The water-supplying capacity is 7 to 8 inches. Roots penetrate to a depth of 40 inches or more.

These soils are used mainly for spring and fall range and watershed catchment areas. They also provide winter grazing for wildlife. Small areas are used for irrigated pasture. These soils are being considered for housing developments.

Representative profile of Bezzant very cobbly loam, 15 to 45 percent slopes, 1.25 miles southeast of Heber "Y" road junction with U.S. Highway 40, 2,240 feet north and 520 feet east of southwest corner of sec. 15, T. 4 S., R. 5 E. in an area of range:

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) cobbly loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft, very friable, slightly sticky and plastic; many fine roots; 50 percent gravel, cobbles, and stones; strongly calcareous; mildly alkaline; abrupt, wavy boundary.

A12—2 to 10 inches, dark grayish-brown (10YR 4/2) very cobbly loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure parting to weak, fine, granular; soft, very friable, slightly sticky and plastic; many fine and few medium roots; 60 percent gravel, cobbles, and stones; moderately calcareous; neutral; clear, wavy boundary.

AC—10 to 16 inches, dark grayish-brown (10YR 4/2) very cobbly loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure parting to weak, fine, granular; soft, friable, slightly sticky and plastic; common fine and few medium roots; 75 percent cobbles, gravel, and stones; strongly calcareous; neutral; clear, wavy boundary.

C1ca—16 to 25 inches, grayish-brown (10YR 5/2) very cobbly clay loam, dark grayish-brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and plastic; few fine roots; 70 percent cobbles, gravel, and stones; strongly calcareous; neutral; clear, wavy boundary.

C2ca—25 to 60 inches, white (10YR 8/2) very cobbly sandy clay loam, pale brown (10YR 6/3) moist; massive; hard, friable, slightly sticky and plastic; 70 percent cobbles, gravel, and stones; very strongly calcareous; mildly alkaline (pH 7.5).

The A1 horizon has value of 4 to 5.5 when dry and 2 or 3 when moist and has chroma of 2. It is 10 to 12 inches thick. The Cca horizon has value of 5 to 8 when dry and 3 to 5 when moist and has chroma of 2 or 3. It is 25 to 35 inches or more thick. The soil ranges from cobbly loam in the upper part to very cobbly clay loam in the lower part.

Bezzant cobbly loam, 10 to 20 percent slopes, eroded (BeD2).—This soil is mainly on southerly alluvial fans and mountain foot slopes. It has a profile similar to the one described as representative of the series, but the surface layer is 20 to 50 percent cobbles. Runoff is medium, and the hazard of erosion is very high in irrigated areas and slight in nonirrigated areas. Included in mapping are small areas of Deer Creek and Watkins Ridge soils. Also included are some areas of Bezzant soils that have slopes of less than 10 percent.

The soil provides spring and fall range for livestock and winter range for deer, and it also serves as watershed catchment areas for water. Small areas are used for irrigated pasture. Capability units IVe-34 irrigated, VIIs-U nonirrigated; Upland Stony Loam range site, wildlife groups 2141-I and 3242.

Bezzant very cobbly loam, 6 to 10 percent slopes (BfC).—This mapping unit is mainly on alluvial fans. Runoff is medium, and the hazard of erosion is slight in nonirrigated areas and high in irrigated areas. Included in mapping are small areas of Deer Creek, Clegg, and Watkins Ridge soils.

The soil provides spring and fall range for livestock and winter range for deer. It also serves as a catchment area for water. Capability unit VIIs-U nonirrigated; Upland Stony Loam range site; wildlife group 3242.

Bezzant very cobbly loam, 15 to 45 percent slopes (BGE).—This soil is mainly on southerly mountainsides. It has the profile described as representative of the series. Runoff is medium, and the hazard of erosion is moderate. Included with this soil in mapping and making up about 20 percent of the acreage, are areas of Bezzant soils that have slopes of 45 to 70 percent. Also included are areas of Deer Creek and Watkins Ridge soils that make up about 10 percent of the acreage.

The soil provides spring and fall range for livestock and winter range for deer. It also serves as a catchment area for water. Capability unit VIIs-U nonirrigated; Upland Stony Loam range site; wildlife group 3242.

Brad Series

The Brad series consists of well-drained, shallow very cobbly soils. These soils formed on mountainsides in residuum derived from sandstone. Slopes range from 15 to 65 percent. The elevation ranges from 6,000 to 7,000 feet. The vegetation is mainly oakbrush, big sagebrush, birchleaf, mountainmahogany, serviceberry, bitterbrush, Indian ricegrass, and needleandthread. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 45° F., and the frost-free period is 50 to 70 days.

In a representative profile the surface layer is brown and reddish-brown very cobbly loamy sand about 10 inches thick. It is underlain by light reddish-brown sandstone bedrock. The soil is neutral.

Brad soils are rapidly permeable. Available water capacity is 0.3 to 0.5 of an inch. The water-supplying capacity is 1.5 to 2.5 inches. The depth to which roots can penetrate is 10 to 20 inches. These soils serve as a catchment area for water. They also provide spring

and fall range for livestock, winter grazing for wildlife, and sites for recreation.

Representative profile of Brad very cobbly loamy sand, in an area of Brad-Rock outcrop complex, 15 to 65 percent slopes, 9.4 miles east from the center of Heber on the Lake Creek Road, 1,480 feet west and 1,440 feet north of southeast corner of sec. 4, T. 4 S., R. 6 E. in an area of range:

O1—2 inches to 0, organic litter, leaves, and twigs.
A11—0 to 3 inches, brown (7.5YR 4/3) very cobbly loamy sand, dark brown (7.5YR 3/2) moist; single grained; loose, nonsticky, nonplastic; many fine and common medium roots; 70 percent angular gravel, cobbles, and stones; neutral; clear, wavy boundary.
A12—3 to 10 inches, reddish-brown (5YR 4/3) very cobbly loamy sand, dark reddish brown (5YR 3/3) moist; single grained; loose, nonsticky, nonplastic; many fine and common medium roots; 70 percent gravel, cobbles and stones; neutral.
R—10 inches, light reddish-brown (5YR 6/4) sandstone bedrock, yellowish red (5YR 4/6) moist.

Depth to bedrock ranges from 10 to 20 inches. The A1 horizon has value of 4 or 5 when dry and 3 when moist and has chroma of 2 or 3. It is 6 to 12 inches thick. In places this soil has a C horizon, as much as 8 inches thick, that has value of 6 when dry and 4 or 5 when moist and has chroma of 2 to 4. The soil is very cobbly loamy sand to very cobbly sand throughout.

Brad-Rock outcrop complex, 15 to 65 percent slopes (BHF).—This mapping unit is on mountainsides. It is about 60 percent Brad very cobbly loamy sand, 15 to 65 percent slopes, 30 percent Rock outcrop; and 10 percent other soils. The Rock outcrop part is mainly barren rock and reddish-colored sandstone mantled with less than 4 inches of soil material. Runoff is slow on the lesser slopes to very rapid on the steep barren rock. The erosion hazard is high.

Included with this unit in mapping are small areas of soils more than 20 inches deep and small areas of finer textured soils.

This mapping unit is used mainly as spring and fall range for livestock. It also provides winter grazing for wildlife. In places the rocks are quarried for building stone. Capability unit VIIs-M nonirrigated; Mountain Shallow Loam range site; wildlife group 4444.

Bradshaw Series

The Bradshaw series consists of well-drained, very cobbly soils. These soils formed on southerly and westerly exposures of mountainsides in colluvium derived from mixed sedimentary rocks. Slopes range from 40 to 60 percent. The elevation ranges from 6,000 to 8,000 feet. The vegetation is mainly sagebrush, serviceberry, birchleaf mountainmahogany, oakbrush, wheatgrasses, and native bluegrasses. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is about 44° F, and the frost-free period is 50 to 70 days.

In a representative profile the surface layer is dark grayish-brown very cobbly very fine sandy loam about 11 inches thick. The subsoil is brown very cobbly very fine sandy loam about 18 inches thick. The substratum is brown very cobbly loam that extends to a depth of 62 inches. The soil is mildly alkaline.

Bradshaw soils are moderately permeable. The available water capacity is about 4 inches. The water-supplying capacity is 9 to 10 inches. Roots can penetrate to a depth of 60 inches or more.

These soils provide range for livestock and wildlife.

Representative profile of Bradshaw very cobbly very fine sandy loam, 40 to 60 percent slopes, about 5 miles southeast of Heber, 2,320 feet south and 1,600 feet east of the northwest corner of sec. 26, T. 4 S., R. 5 E. in an area of range. Laboratory data available.

A11—0 to 3 inches, dark grayish-brown (10YR 4/2) very cobbly very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; 60 percent angular cobbles and gravel; mildly alkaline; clear, wavy boundary.
A12—3 to 11 inches, dark grayish-brown (10YR 4/2) very cobbly very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; 50 percent angular cobbles and gravel; mildly alkaline; clear, wavy boundary.
B2—11 to 29 inches, brown (10YR 5/3) very cobbly very fine sandy loam, brown (10YR 4/3) moist; very weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; 65 percent angular cobbles and gravel; noncalcareous with slightly calcareous pockets and thin lime coatings on some rocks; mildly alkaline; clear, irregular boundary.
C1—29 to 40 inches, brown (10YR 5/3) very cobbly loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; 70 percent angular cobbles and gravel; slightly calcareous with thick lime coatings on rocks; mildly alkaline; clear, wavy boundary.
C2—40 to 62 inches, brown (10YR 5/3) very cobbly loam, brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; few fine roots; 80 percent angular cobbles and gravel; noncalcareous with thin lime coatings on some rock; mildly alkaline.

The A horizon has value of 3 to 5 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 9 to 20 inches thick. The B horizon has value of 5 or 6 when dry and 4 when moist and has chroma of 2 to 4. It ranges from very cobbly very fine sandy loam to very gravelly fine sandy loam and is 10 to 22 inches thick. The C horizon has hue of 10YR or 1.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 2 or 3. It ranges from very cobbly loam to very gravelly sandy loam to a depth of 60 inches or more.

Bradshaw very cobbly very fine sandy loam, 40 to 60 percent slopes (BKF).—This soil is mainly on southerly and westerly exposures of mountainsides. It has the profile described as representative of the series. Runoff is rapid, and the hazard of erosion is high. Included in mapping are small areas of Agassiz and Burgi soils, some areas of Rock outcrop, and pockets of a soil that is 30 to 60 inches deep over bedrock.

This soil provides range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIIs-M nonirrigated; Mountain Stony Loam range site; wildlife group 3242.

Bradshaw-Henefer association, very steep (BLF).—This mapping unit is on mountainsides dissected by canyons. It is about 50 percent Bradshaw very cobbly very fine sandy loam, 40 to 60 percent slopes, 35 percent Henefer silt loam, 25 to 50 percent slopes, and 15 percent other soils and Rock outcrop. The Bradshaw soil is on the southerly exposures, and the

Henefer soil is on the easterly and northerly exposures. Runoff is rapid, and the hazard of erosion is moderate for the Henefer soils and high for the Bradshaw soils.

Included with this unit in mapping are areas of Henefer cobbly silt loam, 25 to 50 percent slopes, and a few areas of Rock outcrop.

This mapping unit provides spring and fall range for livestock and wildlife. It also serves as catchment areas for water and provides sites for recreation. Bradshaw soil in capability unit VIIs-M nonirrigated, Mountain Stony Loam range site, wildlife group 3242; Henefer soil in capability unit VIIe-M nonirrigated, Mountain Loam range site, wildlife group 3141.

Bradshaw-Wallsburg association, very steep (BMF).—This mapping unit is on southerly exposures of mountainsides. It is about 55 percent Bradshaw very cobbly very fine sandy loam, 40 to 60 percent slopes, 35 percent Wallsburg very cobbly sandy clay loam, 20 to 60 percent slopes, and 15 percent other soils and Rock outcrop. The Bradshaw soil is in the swales or on concave slopes, and the Wallsburg soil is mainly on the ridges. Runoff is rapid, and the hazard of erosion is high.

This mapping unit is used mainly as spring and fall range for livestock and winter range for wildlife. It also serves as catchment areas for water and provides sites for recreation. Capability unit VIIs-M nonirrigated; Bradshaw soil in Mountain Stony Loam range site and wildlife group 3242; Wallsburg soil in Mountain Shallow Loam range site and wildlife group 4343.

Broadhead Series

The Broadhead series consists of well-drained soils. These soils formed on terminal moraines, mountainsides, and alluvial fans in alluvium and colluvium derived from andesite. Slopes range from 5 to 60 percent. The elevation ranges from 6,000 to 7,000 feet. The vegetation is mainly wheatgrasses, native bluegrasses, oakbrush, snowberry, geranium, and lupine. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 44° F, and the frost-free period is ordinarily 50 to 70 days. Soils of the irrigated valleys have a frost-free period of about 80 days.

In a representative profile the surface layer is dark grayish-brown very cobbly loam and heavy loam about 12 inches thick. The subsoil is about 32 inches thick. It is brown clay in the upper 22 inches and light-brown clay loam in the lower 10 inches. The substratum is pale-brown silt loam to a depth of 60 inches. The soil is mainly neutral but ranges to slightly acid to mildly alkaline in some layers.

Bradshaw soils are slowly permeable. The available water capacity is 9 to 10 inches. The water-supplying capacity is 15 to 18 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used mainly as range for livestock and wildlife. They also serve as catchment areas for water and provide sites for recreation. Broadhead very cobbly loam, 40 to 60 percent slopes, is mapped only as part of the Broadhead-Little Pole association, very steep.

Representative profile of Broadhead very cobbly loam, 40 to 60 percent slopes, in an area of Broadhead-Little Pole association, very steep, 2.5 miles northeast of Heber, 2,640 feet west and 1,000 feet south of northeast corner of sec. 21, T. 3 S., R. 5 E. in an area of range. Laboratory data available.

A11—0 to 5 inches, dark grayish-brown (10YR 4/2) very cobbly loam, very dark brown (10YR 2/2) moist; weak, thin, platy structure parting to moderate, fine, granular; soft, very friable, nonsticky and slightly plastic; many fine and medium roots; 50 percent cobbles and stones, mainly as a mantle; neutral; clear, wavy boundary.

A12—5 to 12 inches, dark grayish-brown (10YR 4/2) heavy loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; neutral; clear, wavy boundary.

B2t—12 to 34 inches, brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; strong, fine and medium, angular blocky structure; extremely hard, extremely firm, very sticky and very plastic; few fine and medium roots; few fine pores; moderately thick, continuous clay films on peds and in pores; slightly acid; clear, smooth boundary.

B3—34 to 44 inches, light-brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; very hard, very firm, very sticky and very plastic; few fine roots; few fine pores; few thin clay films on faces of some peds and in pores; mildly alkaline; wavy, diffuse boundary.

C—44 to 60 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; firm, sticky and slightly plastic; neutral.

Dark colors extend to a depth of more than 20 inches. The A1 horizon has value of 3 or 4 when dry and 2 or 3 when moist. It is 5 to 19 inches thick. Cobbles and stones are mostly in the uppermost few inches and range from a few to more than 50 percent. The B2t horizon has value of 4 to 6 when dry and 3 or 4 when moist and has chroma of 3 or 4. It ranges from clay to heavy clay loam and is cobbly in places.

Broadhead very cobbly loam, 15 to 40 percent slopes (BOE).—This soil is mainly on mountainsides. Runoff is medium to rapid, and the hazard of erosion is moderate. Included in mapping are areas that have steeper slopes and small areas of soils that have less than 50 percent cobbles in the surface layer.

The soil is used mainly for spring and fall range for livestock and winter range for deer. Capability unit VIIs-M nonirrigated; Mountain Loam range site; wildlife group 3141.

Broadhead-Little Pole association, moderately steep (BPC).—This mapping unit is on sloping or rolling mountain areas that are mantled with glacial drift. It is about 40 percent Broadhead loam and 20 percent Broadhead cobbly loam, both of which have slopes of 6 to 15 percent; 30 percent Little Pole very cobbly sandy clay loam, 6 to 25 percent slopes; and 10 percent other soils and Rock outcrop. The Broadhead soils are mainly in swales and basins where the glacial drift mantle is thicker. The Little Pole soils are mainly on the ridges and knolls that have little or no glacial drift mantle. The Broadhead soils have profiles similar to the one described as representative of the series, but Broadhead loam has less than 20 percent cobbles and Broadhead cobbly loam has 20 to 50 percent cobbles in the surface layer. Runoff is medium, and the hazard of erosion is slight.

Included with this unit in mapping are small areas of Broadhead soils that are steeper and some areas of soils that have slopes of less than 6 percent. Also

included are small areas of Broadhead very cobbly loam and a few scattered areas of Rock outcrop.

This mapping unit is used mainly as spring and fall range for livestock and winter range for deer. It also serves as a catchment area for water and provides sites for recreation. Some areas are being developed for summer homes. Broadhead soil in capability unit VIe-M nonirrigated, Mountain Loam range site, wildlife group 2141; Little Pole soil in capability unit VIIs-M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343.

Broadhead-Little Pole association, hilly (BPD).—This mapping unit is on mountain areas that are mantled with glacial drift. It is about 35 percent Broadhead loam and 20 percent Broadhead cobbly loam, both of which have slopes of 15 to 25 percent; 30 percent Little Pole very cobbly sandy clay loam, 6 to 25 percent slopes; and 15 percent other soils and Rock outcrop. Broadhead soils are mainly in swales and basins where the glacial drift is thicker. Broadhead cobbly loam is intermingled in patches with Broadhead loam. Little Pole soils are on the ridges and knolls that have little or no glacial drift mantle. The Broadhead soils have profiles similar to the one described as representative for the series, but Broadhead loam has less than 20 percent cobbles and Broadhead cobbly loam has 20 to 50 percent cobbles in the surface layer. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Included with this unit in mapping are small areas of Broadhead very cobbly loam, a few scattered areas of Rock outcrop, and small basinlike areas of Broadhead soils that are not so steep.

This mapping unit is used mainly as spring and fall range for livestock and as winter range for deer. It also serves as a catchment area for water and provides sites for recreation. Some areas are being developed for summer homes. Broadhead soil in capability unit VIe-M nonirrigated, Mountain Loam range site, wildlife group 2141; Little Pole soil in capability unit VIIs-M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343.

Broadhead-Little Pole association, steep (BPE).—This mapping unit is on mountainsides that are mantled with glacial drift. It is about 35 percent Broadhead loam, 20 percent Broadhead cobbly loam, and 30 percent Little Pole very cobbly sandy clay loam, all of which have slopes of 25 to 40 percent, and 15 percent other soils and Rock land. The Broadhead soils are mainly on the thickly mantled concave slopes. The Little Pole soil is on the ridges and convex rocky slopes that have few or no glacial drift deposits. These Broadhead soils have profiles similar to the one described as representative of the series, but Broadhead loam has fewer than 20 percent cobbles and Broadhead cobbly loam has 20 to 50 percent cobbles in the surface layer. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Included with this unit in mapping are small areas of Broadhead very cobbly loam and about 5 percent Rock land.

This mapping unit is used mainly as spring and fall range for livestock and as winter range for deer. It also serves as a catchment area for water and provides sites for recreation. Broadhead soils in capability unit VIe-M nonirrigated, Mountain Loam range site, wildlife group 2141; Little Pole soil in capability unit VIIs-M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343.

Broadhead-Little Pole association, very steep (BPF).—This mapping unit is on mountainsides that are mantled with glacial drift. It is about 35 percent Broadhead very cobbly loam, 20 percent Broadhead cobbly loam, and 30 percent Little Pole very cobbly sandy clay loam, all of which have slopes of 40 to 60 percent, and 15 percent other soils and Rock land. The Broadhead soils are mainly on the concave slopes where the glacial drift is thicker. The Little Pole soil is on the ridges and convex rocky slopes that have little or no glacial drift deposited. Broadhead very cobbly loam has the profile described as representative of the series. Broadhead cobbly loam has a similar profile, but has 20 to 50 percent cobbles in the surface layer. The Little Pole soil has the profile described as representative of the Little Pole series. Runoff is rapid, and the hazard of erosion is high.

Included with this unit in mapping are small areas of Broadhead loam and about 5 percent Rock land associated mainly with Little Pole soils.

This mapping unit is used mainly as spring and fall range for livestock and as winter range for deer. It also serves as a catchment area for water and provides sites for recreation. Broadhead very cobbly loam in capability unit VIIs-M nonirrigated and Broadhead loam and cobbly loam in capability unit VIIe-M nonirrigated, Mountain Loam range site, wildlife group 3141; Little Pole soil in capability unit VIIs-M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343.

Broadhead soils, 6 to 15 percent slopes (BTC).—This mapping unit is on alluvial fans and rolling terminal moraines. It is about 55 percent Broadhead loam, 6 to 15 percent slopes; 30 percent Broadhead cobbly loam, 6 to 15 percent slopes; and 15 percent other soils. Generally these soils are intermingled, but either soil can dominate in some areas. These soils have profiles similar to the one described as representative of the series, but Broadhead loam has less than 20 percent cobbles and Broadhead cobbly loam has 20 to 50 percent cobbles in the surface layer. Runoff is slow to medium, and the hazard of erosion is slight.

Included with this unit in mapping are small areas of Broadhead soils that are steeper and some that have slopes of less than 6 percent. Also included are areas of Broadhead very cobbly loam and Rasband coarse sandy loam.

This mapping unit is used mainly as spring and fall range for livestock and as winter range for deer. It also serves as a catchment area for water and provides sites for recreation. In the vicinity of Keetley, some of these soils are used to produce irrigated hay and pasture. Some areas are being developed for summer homes. Broadhead loam in capability units IIIe-3 irrigated and VIe-M nonirrigated, and Broadhead cobbly loam in capability units IVe-34 irrigated and VIe-M nonirrigated; Mountain Loam range site; wildlife group 2141.

Broadhead soils, 15 to 25 percent slopes (BTD).—This mapping unit is on terminal moraines of mountainsides and alluvial fans. It is about 55 percent Broadhead loam and 30 percent Broadhead cobbly loam, both of which have slopes of 15 to 25 percent, and 15 percent other soils. Generally, these soils are intermingled, but either soil can dominate in a given area. These soils have profiles similar to the one described as representative of the series, but Broadhead loam has less than 20 percent cobbles and Broadhead cobbly loam has 20 to 50 percent cobbles in the surface layer. Runoff is medium, and the hazard of erosion is moderate.

Included with this unit in mapping are areas of Broadhead very cobbly loam and Rasband coarse sandy loam, both of which have slopes of 15 to 25 percent. Also included are small, basinlike areas of Broadhead loam and cobbly loam that have slopes of less than 15 percent.

This mapping unit is used mainly as spring and fall range for livestock and as winter range for deer. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe-M nonirrigated; Mountain Loam range site; wildlife group 2141.

Broadhead soils, 25 to 40 percent slopes (BTE).—This mapping unit is on steep mountainsides that are mantled with glacial drift. It is about 55 percent Broadhead loam, 25 to 40 percent slopes; 35 percent Broadhead cobbly loam, 25 to 40 percent slopes, and 10 percent other soils. Generally these soils are intermingled, but either soil can dominate in a given area. These soils have profiles similar to the one described as representative of the series, but Broadhead loam has less than 20 percent cobbles and Broadhead cobbly loam has 20 to 50 percent cobbles in the surface layer. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Included with this unit in mapping are patches of Broadhead very cobbly loam and small areas of Little Pole very cobbly loam.

This mapping unit is used mainly as spring and fall range for livestock and winter range for deer. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe-M nonirrigated; Mountain Loam range site; wildlife group 2141.

Broadhead soils, 40 to 60 percent slopes (BTF).—This mapping unit is on very steep mountainsides that are mantled with glacial drift. It is about 55 percent Broadhead loam, 40 to 60 percent slopes; 35 percent Broadhead cobbly loam, 40 to 60 percent slopes; and 10 percent other soils. Generally these soils are intermingled, but either soil can dominate in a given area. These soils have profiles similar to the one described as representative of the series, but Broadhead loam has less than 20 percent cobbles and Broadhead cobbly loam has 20 to 50 percent cobbles in the surface layer. Runoff is rapid, and the hazard of erosion is high.

Included with this unit in mapping are small areas of Broadhead very cobbly loam and Little Pole very cobbly sandy clay loam.

This mapping unit is used mainly as spring and fall range for livestock and winter range for deer. It also serves as a catchment area for water and provides sites for recreation. Broadhead loam and cobbly loam in capability unit VIIe-M nonirrigated; Broadhead very cobbly loam in capability unit VIIs-M nonirrigated, Mountain Loam range site; wildlife group 3141.

Buell Series

The Buell series consists of well-drained, gravelly soils. These soils are on mountainsides in colluvium and alluvium derived from quartzite. Slopes range from 6 to 60 percent. The elevation ranges from 8,200 to 9,000 feet. The vegetation is mainly big sagebrush, chokecherry, snowberry, Letterman needlegrass, slender wheatgrass, bluebells, and cinquefoil. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 40° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is dark grayish-brown gravelly loam and very gravelly loam about 29 inches thick. The subsoil is pale-brown and light yellowish-brown very gravelly loam that extends to a depth of 62 inches. The surface layer is medium acid, and the subsoil is strongly acid and medium acid.

Buell soils are moderately permeable. The available water capacity is about 5 inches. The water-supplying capacity is about 14 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as summer range for livestock and wildlife. They also serve as an important catchment area for water and provide sites for recreation.

Representative profile of Buell gravelly loam, 6 to 15 percent slopes, about 10 miles north of Midway, 1,800 feet north and 400 feet west of southeast corner of sec. 32, T. 2 S., R. 4 E. in an area of range. Laboratory data available.

A11—0 to 5 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; loose, very friable, nonsticky and nonplastic; many fine roots; 45 percent angular gravel; medium acid; abrupt, smooth boundary.

A12—5 to 15 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure parting to weak, medium, granular; soft, very friable, nonsticky and slightly plastic; many fine and common medium roots; 45 percent angular gravel; medium acid; clear, wavy boundary.

A13—15 to 29 inches, dark grayish-brown (10YR 4/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure; soft, very friable, nonsticky and slightly plastic; common fine and few medium roots; 55 percent angular gravel; medium acid; abrupt, wavy boundary.

B21—29 to 56 inches, pale-brown (10YR 6/3) very gravelly loam, dark brown (10YR 4/3) moist; weak, fine, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and medium roots; 70 percent angular gravel and cobbles; strongly acid; diffuse boundary.

B22—56 to 60 inches, light yellowish-brown (10YR 6/4) very gravelly loam, dark yellowish brown (10YR 4/4) moist; weak, coarse, subangular blocky structure parting to moderate, very fine, subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; 70 percent angular gravel and cobbles, medium acid; clear, smooth boundary.

B23—60 to 62 inches, light yellowish-brown (10YR 6/4) very gravelly loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; 70 percent angular gravel and cobbles; strongly acid.

The soil ranges from sandy loam to loam and is 40 to 85 percent angular gravel and cobbles. The A1 horizon has value of 3 or 4 when dry and 1 to 3 when moist. It is 18 to 32 inches thick. The B2 horizon has value of 5 or 6 when dry and 3 or 4 when moist.

Buell gravelly loam, 6 to 15 percent slopes (BVC).—This soil is mainly on alluvial fans and the higher mountainsides. It has the profile described as representative of the series. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of Buell soils that have slopes of 15 to 25 percent.

This soil is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe-H nonirrigated; High Mountain Loam range site; wildlife group 3141.

Buell gravelly loam, 15 to 25 percent slopes (BVD).—This soil is mainly on alluvial fans and the higher mountainsides. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of steeper Buell soils.

This soil is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe-H nonirrigated; High Mountain Loam range site; wildlife group 3141.

Buell gravelly loam, 25 to 60 percent slopes (BVF).—This soil is mainly on mountainsides. Runoff is rapid, and the hazard of erosion is high. Included in mapping are small areas of Buell soils that are not so steep and scattered areas of Rock outcrop.

This soil is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIIe-H nonirrigated; High Mountain Loam range site; wildlife group 3141.

Burgi Series

The Burgi series consists of well-drained gravelly soils. These soils formed on mountainsides in alluvium and colluvium derived from mixed sedimentary rocks. Slopes range from 25 to 60 percent. The elevation ranges from 5,200 to 7,200 feet. The vegetation is mainly oakbrush, birchleaf mountainmahogany, serviceberry, wheatgrasses, Letterman needlegrass, native bluegrasses, and yellowbrush. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is about 44° F, and the frost-free period about 50 to 70 days.

In a representative profile the surface layer is dark grayish-brown and brown gravelly loam about 26 inches thick. The substratum is brown gravelly loam that extends to a depth of 60 inches. The soil is neutral.

Burgi soils are moderately permeable. The available water capacity is 6 to 7 inches. The water-supplying capacity is 11 to 14 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as spring and fall range for livestock and wildlife. They also serve as catchment areas for water and provide sites for recreation.

Representative profile of Burgi gravelly loam, 40 to 60 percent slopes, about 2 miles southeast of Deer Creek Dam, 200 feet south of the northwest corner of sec. 16, T. 5 S., R. 4 E. Laboratory data available.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/3) moist; weak, fine, granular structure; loose, very friable, nonsticky and nonplastic; many fine roots; 20 percent angular gravel, cobbles, and stones; neutral; abrupt, wavy boundary.

A12—2 to 12 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; weak, medium and fine, subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium and few large roots; 20 percent angular gravel, cobbles, and stones; neutral; clear, wavy boundary.

A13—12 to 26 inches, brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; weak, medium and fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium and few large roots; 45 percent angular gravel, cobbles, and stones; neutral; gradual, wavy boundary.

C1—26 to 39 inches, brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; noncalcareous with some fine flecks of lime; neutral; clear, wavy boundary.

C2—39 to 60 inches, same as the C1 horizon but the soil mass is moderately calcareous; lime occurs as thin coatings on undersides of gravel.

The profile is loam throughout, but some places are heavy loam or range from loam to heavy loam. The A horizon ranges from about 20 percent gravel in the upper part to as much as 70 percent in the lower layers. The A1 horizon has value of 3 to 5 when dry. It is 20 to 30 inches thick. The C horizon has value of 4 to 6 when dry and 2 to 4 when moist and has chroma of 2 or 3.

Burgi gravelly loam, 25 to 40 percent slopes (BWE).—This soil is mainly on north-facing mountainsides. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are small areas of soils that have less than 20 percent gravel in the surface layer and a few areas of Rock outcrop.

The soil is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe-M nonirrigated; Mountain Gravelly Loam (Oakbrush) range site; wildlife group 2141.

Burgi gravelly loam, 40 to 60 percent slopes (BWF).—This soil is mainly on north-facing mountainsides. It has the profile described as representative of the series. Runoff is rapid, and the hazard of erosion is high.

Included with this soil in mapping are similar soils that have less than 20 percent gravel in the surface layer, small areas of Wallsburg soils, and scattered areas of Rock outcrop.

This soil is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIIe-M nonirrigated; Mountain Gravelly Loam (Oakbrush) range site; wildlife group 3141.

Burgi-Agassiz associaton, very steep (BXF).—This mapping unit is on mountainsides. It is about 55 percent Burgi gravelly loam, 40 to 60 percent slopes, 35 percent Agassiz very cobbly loam, 25 to 60 percent slopes, and 15 percent other soils and Rock outcrop. Burgi soil is in the swales and concave areas. The Agassiz soil is on the ridges and convex areas. Runoff is rapid to very rapid, and the hazard of erosion is high.

This mapping unit is used mainly as range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Burgi soil in capability unit VIIe-M nonirrigated, Mountain Gravelly Loam (Oakbrush) range site, wildlife group 3141; Agassiz soil in capability unit VIIs-M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343.

Burgi-Wallsburg association, very steep (BYF).—This mapping unit is on mountainsides. It is about 55 percent Burgi gravelly loam, 40 to 60 percent slopes; 35 percent Wallsburg very cobbly sandy clay loam, 20 to 60 percent slopes; and 10 percent other soils and Rock outcrop. The Burgi soil is mainly in the swales and concave areas. The Wallsburg soil is on the ridges and in convex, ledgy areas. Runoff is rapid to very rapid, and the hazard of erosion is high.

Included with this unit in mapping are pockets of nongravelly soil and areas of Rock outcrop.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Burgi soil in capability unit VIIe-M nonirrigated, Mountain Gravelly Loam (Oakbrush) range site, wildlife group 3141; Wallsburg soil in capability unit VIIs-M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343.

Center Creek Series

The Center Creek series consists of somewhat poorly drained soils. These soils formed on sloping stream terraces in alluvium derived mainly from andesite rocks. Slopes range from 1 to 3 percent. The elevation ranges from 5,500 to 6,000 feet. The vegetation in uncultivated areas is mainly a scattered overstory of native hawthorn, willows, and cottonwoods and an understory of grasses, forbs, and browse plants. The average annual precipitation is 16 to 20 inches, the mean annual air temperature is about 45° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is dark-gray loam about 12 inches thick. The upper part of the subsoil is grayish-brown and pale-brown clay loam about 21 inches thick. The lower part of the subsoil is brown very gravelly coarse sandy loam about 7 inches thick. The substratum is grayish-brown very gravelly sandy loam and very gravelly heavy coarse sandy loam that extends to a depth of 60 inches. The soil is mildly alkaline to neutral.

Center Creek soils are moderately permeable. The available water capacity is 6 to 7 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used for irrigated alfalfa and small grain (barley), irrigated pasture, and native meadow pasture.

Representative profile of Center Creek loam, about 6 miles southeast of Heber, 85 feet south and 124 feet west of the northeast corner of sec. 15, T. 4 S., R. 5 E. in an irrigated field. Laboratory data available.

Ap—0 to 5 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) moist; weak, medium, platy structure parting to weak, fine, subangular blocky; hard, friable, slightly sticky and plastic; many fine roots; neutral; clear, smooth boundary.

A12—5 to 12 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) moist; weak, fine, subangular blocky structure; hard, friable, slightly sticky and plastic; many fine roots; mildly alkaline; clear, wavy boundary.

B1—12 to 20 inches, grayish-brown (10YR 5/2) heavy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure parting to moderate, fine, subangular blocky; very hard, firm, sticky and plastic; common fine roots; few fine pores; thin, continuous organic staining; thin, continuous clay films; noncalcareous with few fine lime veins; mildly alkaline; clear, wavy boundary.

B21t—20 to 27 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, subangular blocky structure parting to moderate, medium, angular blocky; very hard, very firm, sticky and very plastic; common fine roots; few fine pores; thin, continuous organic staining; moderate, continuous clay films on peds; noncalcareous with few fine lime veins; mildly alkaline; clear, irregular boundary.

B22t—27 to 33 inches, pale-brown (10YR 6/3) clay loam, dark grayish brown (10YR 4/2) moist; few, fine, prominent, yellowish-red (5YR 5/6) mottles; moderate, coarse, subangular blocky structure parting to moderate, medium, blocky; hard, firm, slightly sticky and plastic; common fine roots; few fine pores; thin, continuous organic stainings in pockets; moderately thick, continuous clay films on peds; noncalcareous with few fine lime veins; mildly alkaline; clear, wavy boundary.

B3—33 to 40 inches, brown (10YR 5/3) very gravelly coarse sandy loam, dark grayish brown (10YR 4/2) moist; few, fine, prominent, yellowish-red (5YR 5/6) mottles; weak, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; thin, patchy clay films on peds; 50 percent gravel and cobbles; mildly alkaline; clear, wavy boundary.

C1—40 to 50 inches, grayish-brown (10YR 5/2) very gravelly sandy loam, dark grayish brown (10YR 4/2) moist; few, fine, prominent, yellowish-red (5YR 5/6) mottles; massive; soft, friable, slightly sticky and slightly plastic; few fine roots; 50 percent gravel and cobbles; mildly alkaline; gradual, wavy boundary.

C2—50 to 60 inches, grayish-brown (10YR 5/2) very gravelly heavy coarse sandy loam, dark grayish brown (10YR 4/2) moist; massive; soft, friable, slightly sticky and slightly plastic; few fine roots; 70 percent gravel and cobbles; noncalcareous with some pockets of lime; mildly alkaline.

The A1 horizon has a value of 3 or 4 when dry and 2 when moist and has chroma of 1 or 2. It is 8 to 15 inches thick. The B2t horizon has color value of 4 to 6 when dry and 3 or 4 when moist, and has chroma of 2 or 3. It is 13 to 33 inches thick and ranges from silty clay loam to clay loam. Rust mottling occurs withinn 40 inches of the surface in places. Gravel content ranges from 0 to 20 percent. Below the B2t horizon, to a depth of 60 inches or more, gravel content increases from 35 percent to as much as 80 percent. Textures range from very gravelly sandy clay loam to very gravelly coarse sandy loam.

Center Creek loam (Ca).—This soil is mainly on sloping stream terraces. Slopes range from 1 to 3 percent. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping are 2 areas west of Heber totaling about 50 acres where the water table is within 20 inches of the surface. Also included are areas that have an uneven surface and soils that have gravel at a depth of 20 to 36 inches.

This soil is used mainly for irrigated alfalfa and small grain, improved pasture, and irrigated native meadow. Capability unit IIIw-3 irrigated, wildlife group 2121-I.

Clayburn Series

The Clayburn series consists of well-drained soils. These soils formed on high mountain plateaus in glacial drift derived mainly from andesite rocks. Slopes range from 3 to 40 percent. The elevation ranges from 6,800 to 8,000 feet. The vegetation is mainly big sagebrush, snowberry, slender wheatgrass, Columbia needlegrass, mountain bromegrass, peavine, and horsemint. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 40° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is very dark grayish-brown and dark grayish-brown sandy clay loam and loam about 18 inches thick. The subsoil is brown loam and sandy clay loam about 23 inches thick. The substratum is pale-brown gravelly and very gravelly sandy loam that extends to a depth of 60 inches. The soil is slightly acid.

Clayburn soils are moderately permeable. The available water capacity is about 8 inches. The water-supplying capacity is 16 to 18 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as summer range for livestock and wildlife. They also serve as catchment areas for water and provide sites for recreation.

Representative profile of Clayburn loam, 3 to 6 percent slopes, about 12 miles east of Heber, 1,780 feet east and 210 feet south of the northwest corner of sec. 10, T. 4 S., R. 6 E. in an area of range. Laboratory data available.

A11—0 to 2 inches, very dark grayish-brown (10YR 3/2) sandy clay loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many fine and few medium roots; slightly acid; abrupt, wavy boundary.

A12—2 to 12 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak, medium, granular structure; slightly hard, friable, nonsticky and nonplastic; many fine and few medium roots; many fine pores; slightly acid; clear, wavy boundary.

A13—12 to 18 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, fine, subangular blocky structure parting to moderate, medium, granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine pores; slightly acid; abrupt, irregular boundary.

B1—18 to 24 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak, medium and fine, subangular blocky structure; hard, friable, sticky and plastic; many fine pores; slightly acid; clear, wavy boundary. slightly acid; clear, wavy boundary.

B21t—24 to 36 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; weak, coarse, subangular blocky structure parting to moderate, fine, blocky; hard, firm, very sticky and very plastic; many roots; few, fine pores; moderately thick, continuous clay films on peds; slightly acid; clear, wavy boundary.

B22t—36 to 41 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; weak, coarse, subangular blocky structure parting to modearte, fine, blocky; hard, firm, sticky and plastic; many fine roots; few fine pores; thin, patchy clay films on peds; slightly acir; clear, wavy boundary.

C1—41 to 48 inches, pale-brown (10YR 6/3) gravelly sandy loam, dark brown (10YR 4/3) moist; single grained; loose, very friable, nonsticky and nonplastic; few fine roots; 40 percent gravel and cobbles; slightly acid; clear, wavy boundary.

C2—48 to 60 inches, same as C1 horizon but very gravelly and weakly consolidated, 50 percent gravel and cobbles.

The A1 horizon has value of 3 or 4 when dry and 1.5 or 2 when moist and has chroma of 2. It is 16 to 24 inches thick. The B2t horizon has value of 4 or 5 when dry and 3 or 4 when moist and has chroma of 3. It is 17 to 30 inches thick and ranges from sandy clay loam to clay loam. Content of gravel and cobbles ranges from 0 to 30 percent.

Clayburn loam, 3 to 6 percent slopes (CBB).—This soil is mainly on high mountain plateaus that are mantled with glacial drift. It has the profile described as representative of the series. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of Flygare soils in small aspen patches and areas that have a cobbly surface layer.

This soil is used mainly as summer range for livestock and wildlife. It also serves as an important catchment area for water and provides sites for recreation. Capability unit VIe-H nonirrigated; High Mountain Loam range site; wildlife group 3141.

Clayburn loam, 6 to 15 percent slopes (CBC).—This soil is mainly on high mountain plateaus that are mantled with glacial drift. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of steeper Clayburn soils, areas of Flygare soils in small patches of aspen, and areas of soils that have a cobbly surface layer.

This soil is used mainly as summer range for livestock and wildlife. It also serves as an important catchment area for water and provides sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam range site; wildlife group 3141.

Clayburn loam, 15 to 25 percent slopes (CBD).—This soil is mainly on high mountain plateaus that are mantled with glacial drift. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are small areas of Clayburn loam, 6 to 15 percent slopes, and areas of Flygare soils in small patches of aspen.

This soil is used mainly as summer range for livestock and wildlife. It also serves as an important catchment area for water and provides sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam range site; wildlife group 3141.

Clayburn-Flygare association, hilly (CCD).—This mapping unit is on high mountain plateaus that are mantled with glacial drift derived mainly from andesite rocks. It is about 70 percent Clayburn loam and 20 percent Flygare loam, both of which have slopes of 15 to 25 percent, and about 10 percent other soils. The Clayburn soil is in open areas of grass and big sagebrush. The Flygare soil is under patches of aspen. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are areas of Clayburn and Flygare soils that have a cobbly surface layer.

This mapping unit is used mainly as summer range for livestock and wildlife. It also serves as an important catchment area for water and provides sites for recreation. Wildlife group 3141; Clayburn soil in capability unit VIe–H nonirrigated, High Mountain Loam range site; Flygare soil in capability unit VIe–H nonirrigated, High Mountain Loam (Aspen) range site.

Clayburn soils, 25 to 40 percent slopes (CDE).—This mapping unit is in the canyons and tributaries that dissect the high plateau northeast of Heber City.

These soils are intermingled, and either soil can dominate in a given area. It is about 60 percent Clayburn loam and about 30 percent Clayburn cobbly loam, both of which have slopes of 25 to 40 percent, and about 10 percent other soils. Both soils have profiles similar to the one described as representative of the series, but Clayburn cobbly loam has 20 to 50 percent cobbles in the surface layer. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are small, scattered areas of Flygare soils under aspen.

This mapping unit is used mainly as summer range for livestock and wildlife. It also serves as an important catchment area for water and provides sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam range site; wildlife group 3141.

Clegg Series

The Clegg series consists of well-drained soils. These soils formed on alluvial fans of the mountain foot slopes in alluvium derived from andesite and mixed sedimentary rocks. Slopes range from 1 to 25 percent. The elevation ranges from 5,400 to 6,000 feet. The vegetation is mainly big sagebrush, bitterbrush, serviceberry, bluebunch wheatgrass, native bluegrasses, needleandthread, and western wheatgrass. The average annual precipitation is 16 to 18 inches, the mean annual air temperature is about 46° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is dark grayish-brown fine sandy loam and loam about 9 inches thick. The subsoil is brown heavy loam and loam about 21 inches thick. The substratum is very pale brown loam and light loam that extends to a depth of 66 inches. The soil is neutral to slightly acid in the surface layer and subsoil and mildly alkaline in the substratum.

Clegg soils are moderately permeable. The available water capacity is about 10 inches. The water-supplying capacity is 12 to 14 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used for irrigated crops, range, wildlife, and homesites. They also serve as catchment areas for water and provide sites for recreation.

Representative profile of Clegg loam, 6 to 15 percent slopes, about 2 miles northeast of Heber, 2,400 feet south and 1,680 feet west of the northeast corner of sec. 29 T. 3 S., R. 5 E. in an area of range. Laboratory data available.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10 YR 2/2) moist; weak, thin, platy structure parting to weak, fine, granular; soft, very friable, slightly sticky and slightly plastic; many fine roots; neutral; abrupt, wavy boundary.

A12—2 to 9 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure parting to weak, fine, granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; few fine and medium pores; slightly acid; clear, wavy boundary.

B21t—9 to 13 inches, brown (10YR 4/3) heavy loam, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure parting to moderate, fine, subangular blocky; hard, firm, sticky and plastic; common medium roots; few fine and medium pores; thin, continuous clay films on peds; slightly acid; gradual, wavy boundary.

B22t—13 to 21 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; hard, firm, sticky and plastic; few fine roots; few fine pores; thin, continuous clay films on peds; neutral; gradual, wavy boundary.

B23t—21 to 30 inches, brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak, coarse, subangular blocky structure parting to moderate, fine and medium, subangular blocky; hard, firm, sticky and plastic; few fine roots; few fine pores; thin, continuous clay films on peds; neutral; clear, wavy boundary.

C1ca—30 to 40 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; massive; hard, firm, slightly sticky and slightly plastic; few fine roots; 10 percent gravel; strongly calcareous; mildly alkaline; gradual, wavy boundary.

C2ca—40 to 50 inches, very pale brown (10YR 8/3) light loam, light gray (10YR 7/2) moist; massive; very hard, firm slightly sticky and slightly plastic; few fine roots; strongly calcareous; mildly alkaline; gradual, wavy boundary.

C3ca—50 to 66 inches, very pale brown (10YR 7/3) light loam, brown (10YR 5/3) moist; massive; hard, firm, slightly sticky and slightly plastic; strongly calcareous; mildly alkaline.

The A1 horizon has value of 3 to 5 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 8 to 15 inches thick. The B2t horizon has value of 4 or 5 when dry and 2 to 4 when moist and has chroma of 2 or 3. It is 15 to 23 inches thick and ranges from heavy loam to heavy sandy loam. Content of gravel and cobbles ranges from 0 to 30 percent. The Cca horizon has value of 7 or 8 when dry and 4 to 7 when moist and has chroma of 2 to 4. It ranges from loam to heavy sandy loam.

Clegg loam, 1 to 3 percent slopes (CgA).—This soil is mainly on alluvial fans in irrigated areas. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of soil that have a layer of weak lime and areas of Deer Creek loam, 1 to 3 percent slopes.

This soil is used for irrigated alfalfa and barley. Capability unit IIIc–3 irrigated; wildlife group 2141–I.

Clegg loam, 3 to 6 percent slopes (CgB).—This soil is mainly on alluvial fans in irrigated areas. Runoff is slow, and the hazard of erosion is slight. Included in mapping are areas of soils that have a weakly expressed lime layer, areas of soils that have gravel at a depth of 15 to 20 inches, and areas of Deer Creek loam, 3 to 10 percent slopes.

This soil is used for irrigated alfalfa and barley. Capability unit IIIe–3 irrigated; wildlife group 2141–I.

Clegg loam, 6 to 15 percent slopes (CgC).—This soil is mainly on alluvial fans. It has the profile described as representative of the series. Runoff is medium. The hazard of erosion is slight in nonirrigated areas and moderate in irrigated areas. Included with this soil in mapping are small areas of soil that has a weak layer of lime, areas of Clegg soils that have a cobbly surface layer, and areas of soils that have gravel at a depth of 15 to 20 inches.

Most of the acreage is irrigated alfalfa or alfalfa-grass and irrigated pasture. Areas not irrigated provide spring and fall range for livestock. In the irrigated areas slopes are mostly 6 to 10 percent. Capability units IIIe–3 irrigated and VIe–U nonirrigated; Upland Loam range site; wildlife groups 2141 and 2141–I.

Clegg cobbly loam, 5 to 10 percent slopes (ChC).—This soil is mainly on alluvial fans. It has a profile

similar to the one described as representative of the series, but the surface layer is 20 to 50 percent cobbles. Runoff is slow. The hazard of erosion is slight in nonirrigated areas and moderate in irrigated areas. Included with this soil in mapping are small areas of soils that have a noncobbly surface layer, areas of soils that have a weak layer of lime, and areas of soils that have a very cobbly surface layer.

Most of the acreage is irrigated hay and pasture. Areas not irrigated provide spring and fall range for livestock. Capability units IVe–34 irrigated and VIe–U nonirrigated; Upland Loam range site; wildlife groups 2141 and 2141–I.

Cloud Rim Series

The Cloud Rim series consists of well-drained soils. These soils formed on southerly mountainsides, alluvial fans, and colluvial cones in alluvium and colluvium derived from mixed sedimentary rocks. Slopes range from 10 to 60 percent. The elevation ranges from 6,300 to 7,000 feet. The vegetation is mainly oakbrush, big sagebrush, serviceberry, snowberry, mountain laurel, bearded wheatgrass, and Letterman needlegrass. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is about 44° F, and the frost-free period is about 50 to 70 days.

In a representative profile the surface layer is grayish-brown loam about 14 inches thick. The subsoil is light-brown heavy loam and loam that extends to a depth of 60 inches. The soil is neutral to slightly acid.

Cloud Rim soils are moderately permeable. The available water capacity is 10 to 11 inches. The water-supplying capacity is 15 to 18 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as spring and fall range for livestock and winter range for wildlife. They also serve as catchment areas for water and provide sites for recreation.

Representative profile of Cloud Rim loam, 40 to 60 percent slopes, about 4 miles northwest of Midway Post Office, 1,920 feet west and 1,280 feet south of northeast corner of sec. 20, T. 3 S., R. 4 E. in an area of range. Laboratory data available.

A11—0 to 2 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; loose, very friable, nonsticky and nonplastic; many fine and medium roots; 5 percent gravel; neutral; clear, wavy boundary.

A12—2 to 14 inches, grayish-brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure parting to moderate, coarse, granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; common fine pores; 5 percent gravel; neutral; abrupt, wavy boundary.

B2t—14 to 54 inches, light-brown (7.5YR 6/4) heavy loam, brown (7.5YR 4/3) moist; moderate, coarse, subangular blocky structure parting to moderate, fine and medium, subangular blocky; hard, firm, sticky and plastic; common fine and medium roots; 5 percent gravel; common fine pores; thin, continuous clay films on peds; neutral; gradual, wavy boundary.

B3—54 to 60 inches, light-brown (7.5YR 6/4) loam, brown (7.5YR 4/3) moist; weak, coarse, subangular blocky structure parting to moderate, fine and medium, subangular blocky; slightly hard, friable, sticky and plastic; few fine roots; few thin clay films on ped faces; 5 percent gravel; slightly acid.

The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 10 to 15 inches thick. The B2t horizon has value of 5 or 6 when dry and 3 or 4 when moist and has chroma of 3 or 4. It is 40 to 50 inches thick and ranges from loam to heavy loam. Content of gravel ranges from 0 to 20 percent.

Cloud Rim loam, 10 to 25 percent slopes (CMD).—This soil is mainly on alluvial fans and mountainsides. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are areas of Cloud Rim soil that have 20 to 50 percent cobbles in the surface layer and small areas of Henefer soils.

This soil is used mainly as spring and fall range for livestock and winter range for deer. It also serves as a catchment area for water and provides sites for recreation. In places this soil is used as sites for summer homes. Capability unit VIe–M nonirrigated; Mountain Loam range site; wildlife group 2141.

Cloud Rim loam, 25 to 40 percent slopes (CME).—This soil is mainly on mountainsides and colluvial cones in the mountain areas. Runoff is rapid, and the hazard of erosion is moderate. Included in mapping are areas of Cloud Rim soils that have 20 to 50 percent cobbles in the surface layer and areas of Henefer soils.

This soil is used mainly as spring and fall range for livestock and winter range for wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe–M nonirrigated; Mountain Loam range site; wildlife group 2141.

Cloud Rim soils, 40 to 60 percent slopes (CNF).—This mapping unit is on southerly mountainsides. It is about 60 percent Cloud Rim loam and 30 percent Cloud Rim cobbly loam, both of which have slopes of 40 to 60 percent, and about 10 percent other soils. These soils are intermingled and either soil can dominate in a given area. Cloud Rim, 40 to 60 percent slopes, has the profile described as representative of the series. Cloud Rim cobbly loam has a profile similar to the one described as representative of the series, but the surface layer is 20 to 50 percent cobbles. Runoff is rapid, and the hazard of erosion is high. Included in mapping are small areas of Wallsburg soil.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIIe–M nonirrigated; Mountain Loam range site; wildlife group 3141.

Cluff Series

The Cluff series consists of well-drained, very cobbly soils. These soils formed mainly on northerly sides of the higher mountains in residuum derived from mixed sedimentary rocks. Slopes range from 6 to 60 percent. The elevation ranges from 8,000 to 8,500 feet. The vegetation is mainly spruce-fir and intermingled scattered aspen. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 36° to 42° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is

brown cobbly light loam about 9 inches thick. The subsurface layer is light brownish-gray very cobbly loam about 5 inches thick. The subsoil is about 22 inches thick. The upper 15 inches is reddish-brown, very cobbly heavy clay loam and very cobbly clay. The lower 7 inches is brown very cobbly sandy clay loam. Below the subsoil is fractured sandstone bedrock. The soil is slightly to medium acid in the surface layer and strongly acid in the subsoil.

Cluff soils are slowly permeable. The available water capacity is about 4 inches. The water-supplying capacity is 10 to 13 inches. Roots can penetrate to a depth of 40 to 60 inches.

These soils are used as woodland and for wildlife habitat. They also serve as catchment areas for water and provide sites for recreation.

Representative profile of Cluff cobbly loam, in an area of Cluff soils, 6 to 15 percent slopes, about 25 miles southeast of Heber, 1,480 feet north and 1,440 feet east of southwest corner of sec. 24, T. 5 S., R. 5 E. in an area of woodland. Laboratory data available.

O1—1 inch to 0, conifer needles and litter.

A11—0 to 1 inch, very dark brown (10YR 2/2) silt loam, very dark brown (10YR 1/2) moist; weak, very fine, granular structure; loose, very friable, nonsticky and nonplastic; many fine roots; slightly acid; abrupt, wavy boundary.

A12—1 to 9 inches, brown (10YR 5/3) cobbly light loam, dark brown (10YR 3/3) moist; weak, coarse and fine, subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; many fine, medium, and large roots; many, fine and medium, vesicular pores; thick, continuous gray coatings; 40 percent cobbles and gravel; medium acid; clear, wavy boundary.

A2—9 to 14 inches, light brownish-gray (10YR 6/2) very cobbly loam, brown (10YR 4/3) moist; massive; very hard, friable, slightly sticky and slightly plastic; many fine, medium, and large roots; many fine vesicular pores; 60 percent gravel and cobbles; thick, continuous gray coatings; medium acid; clear, irregular boundary.

B21t—14 to 21 inches, reddish-brown (5YR 4/4) very cobbly heavy clay loam, dark reddish brown (5YR 3/4) moist; strong, coarse and medium, angular blocky structure; extremely hard, extremely firm, very sticky and very plastic; few medium and large roots; 60 percent gravel and cobbles; thick, continuous clay films on peds; thick gray coatings on some pockets; very strongly acid; diffuse, wavy boundary.

B22t—21 to 29 inches, reddish-brown (5YR 4/4) very cobbly clay, dark reddish brown (5YR 3/4) moist; strong, coarse and medium, angular blocky structure; extremely hard, extremely firm, very sticky and very plastic; few medium roots; 60 percent gravel and cobbles; thick, continuous clay films on peds; thin gray coatings on a few pockets; very strongly acid; clear, irregular boundary.

B23t—29 to 36 inches, brown (7.5YR 5/4) very cobbly sandy clay loam, dark brown (7.5YR 4/4) moist; strong, coarse and medium, angular blocky structure; extremely hard, very sticky, and very plastic; few medium roots; 80 percent gravel and cobbles; common, moderately thick clay films on peds; very strongly acid; abrupt, irregular boundary.

R—36 to 50 inches, fractured sandstone.

The A1 horizon has value of 2 or 3 when dry and 1 or 2 when moist and has chroma of 2. It is 6 to 9 inches thick. The A2 horizon has value of 5 or 6 when dry and 4 when moist and has chroma of 2 or 3. It is 4 to 15 inches thick. The B2t horizon has hue of 7.5YR to 2.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 4 to 6. It ranges from very cobbly heavy clay loam to very cobbly clay. Tonguing of the A2 horizon into the B2 horizon is nearly absent in places and clearly evident in others.

Cluff-Daybell association, very steep (COF).—This mapping unit is on the sides of the higher mountains. It is about 30 percent Cluff cobbly loam and 30 percent Cluff loam, both of which have slopes of 40 to 60 percent, and 20 percent Daybell loam and 20 percent Daybell gravelly loam, both of which have slopes of 40 to 65 percent. The Cluff soils are under dense stands of spruce and fir. The Daybell soils are under aspen interspersed with some spruce and fir. Both Cluff soils have profiles similar to the one described as representative of the series, but they are steeper and Cluff loam has less than 20 percent cobbles in the surface layer. Daybell loam in this unit has the profile described as representative of the series. Daybell gravelly loam has a profile similar to the one described as representative of the series, but it is 20 to 50 percent gravel. Runoff is rapid, and the hazard of erosion is high.

The Cluff soils are used mainly for woodland and wildlife habitat. They also serve as catchment areas for water. The Daybell soils are used mainly as summer range for livestock and wildlife. They also serve as catchment areas for water. Both soils provide sites for recreation. Wildlife group 3141; Cluff soils in capability unit VIIe–HC nonirrigated, woodland; Daybell soils in capability unit VIIs–H nonirrigated, High Mountain Stony Loam (Aspen) range site.

Cluff soils, 6 to 15 percent slopes (CPC).—These gently to strongly sloping soils are on the sides of the higher mountains. Areas are about 45 percent Cluff cobbly loam and 45 percent Cluff loam, both of which have about 10 percent other soils. These soils are intermingled, and either soil can dominate in a given area. Cluff cobbly loam has the profile described as representative of the series. Cluff loam has a similar profile, but its surface layer is less than 20 percent cobbles. Runoff is slow, and the hazard of erosion is slight. Included in mapping are areas of Sessions soils in small grassy parks and Roundy soils under aspens.

These soils are used mainly for woodland. They also serve as a catchment area for water and provide sites for recreation. In places they are used as sites for summer homes. Capability unit VIe–HC nonirrigated; woodland; wildlife group 3141.

Cluff soils, 15 to 25 percent slopes (CPD).—This mapping unit is on moderately steep sides of the higher mountains. These soils are intermingled, and either soil can dominate in a given area. It is about 45 percent Cluff cobbly loam and 45 percent Cluff loam, both of which have slopes of 15 to 25 percent, and about 10 percent other soils. Both soils have profiles similar to the one described as representative of the series, but Cluff loam has less than 20 percent cobbles in the surface layer. Runoff is medium, and the hazard of erosion is moderate. Included with this unit in mapping are areas of Sessions soils in small grassy parks and Roundy soils under aspens.

These soils are used mainly for woodland and wildlife habitat. They also serve as catchment areas for water and provide sites for recreation. Capability unit VIe–HC nonirrigated; woodland; wildlife group 3141.

Cluff soils, 40 to 60 percent slopes (CPF).—This steep mapping unit is on the higher mountainsides. It

is about 45 percent Cluff cobbly loam and 45 percent Cluff loam, both of which have slopes of 40 to 60 percent, and about 10 percent other soils. These soils are intermingled, and either soil can dominate in a given area. These soils have profiles similar to the one described as representative of the series, but Cluff loam has less than 20 percent cobbles in the surface layer. Runoff is rapid, and the hazard of erosion is high. Included in mapping are areas of Roundy and Daybell soils.

These soils are used mainly for woodland and wildlife habitat. They also serve as catchment areas for water and provide sites for recreation. Capability unit VIIe–HC nonirrigated; woodland; wildlife group 3141.

Crooked Creek Series

The Crooked Creek series consists of poorly drained soils. These soils formed on stream terraces, flood plains, and alluvial fans in alluvium derived from mixed rocks. Slopes range from 1 to 10 percent. The elevation ranges from 5,500 to 6,000 feet. The vegetation is mainly sedges, tules, rushes, timothy, redtop, clover, foxtail, and some willows. The average annual precipitation is 16 to 20 inches, the mean annual air temperature is about 46° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is dark-gray clay loam about 12 inches thick. The substratum extends to a depth of 70 inches or more. The upper 21 inches is dark-gray clay loam and silty clay, and the lower part is grayish-brown and light olive-brown clay loam. The soil is mildly alkaline to moderately alkaline in the upper 23 inches and neutral below a depth of 23 inches.

Crooked Creek soils are very slowly permeable. The available water capacity is 10 to 11 inches. Roots are mainly above the water table, usually in the upper 1 to 2 feet, but they extend throughout the profile.

These soils are used for meadow, hay, and pasture. If drained, they are suitable for irrigated alfalfa and small grain. Drainage is generally difficult because soil texture is fine and there is a lack of suitable outlets.

Representative profile of Crooked Creek clay loam, 1 to 3 percent slopes, near Heber at a point 400 feet northeast of Heber sewage plant, 2,630 feet south and 2,300 feet west of northeast corner of sec. 31, T. 3 S., R. 5 E., in a native meadow. Laboratory data available.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) clay loam, black (10YR 2/1) moist; weak, thick, platy structure parting to strong, fine, granular; hard, firm, slightly sticky and slightly plastic; many fine roots; mildly alkaline; abrupt, smooth boundary.

A12—2 to 12 inches, dark-gray (10YR 4/1) clay loam, black (10YR 2/1) moist; strong, medium and coarse, granular structure; very hard, firm, sticky and slightly plastic; many medium roots; few fine pores; moderately alkaline; clear, smooth boundary.

C1—12 to 23 inches, dark-gray (10YR 4/1) clay loam, black (10YR 2/1) moist; few, medium, faint mottles; weak, medium, prismatic structure parting to strong, fine and medium, blocky; extremely hard, very firm, sticky and plastic; many fine and medium roots; few fine pores; mildly alkaline; clear, smooth boundary.

C2—23 to 33 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) moist; few, medium, faint mottles; moderate, medium, prismatic structure parting to strong and medium, angular blocky; extremely hard, extremely firm, very sticky and very plastic; common fine and medium roots; few fine pores; neutral; diffuse, smooth boundary.

C3—33 to 42 inches, grayish-brown (2.5Y 5/2) clay loam, very dark grayish brown (1Y 3/2) moist; many, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, very coarse, subangular blocky structure parting to strong, fine and medium, blocky; very hard, firm, sticky and plastic; common fine and medium roots; few fine pores; neutral; diffuse, smooth boundary.

C4—42 to 50 inches, light olive-brown (2.5Y 5/3) clay loam, very dark grayish brown (1Y 3/2) moist; many, large, prominent, dark greenish-gray (5G 4/1) mottles; weak, medium, subangular blocky structure; hard, firm, slightly sticky and plastic; few fine and medium roots; few fine pores; neutral; diffuse, smooth boundary.

C5—50 to 70 inches, grayish-brown (2.5Y 5/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; common, medium, prominent, dark greenish-gray (5G 4/1) mottles; weak, medium, subangular blocky structure; hard, firm, sticky and plastic; few fine and medium roots; few fine pores; neutral.

The A1 horizon has value of 3 or 4 when dry and 1 or 2 when moist and has chroma of 0.5 to 2. It is 7 to 12 inches thick. The upper part of the C horizon, to a depth of 30 or 40 inches, has value of 3 to 5 when dry and 2 to 4 when moist and has chroma of 0 to 2. It ranges from silty clay to clay loam. The lower part of the C horizon, between depths of 40 and 60 inches, has value of 5 or 6 when dry and 3 or 4 when moist and has chroma of 1 to 3. Faint mottling occurs in the upper part of the C horizon, and distinct or prominent mottling ranging in hue from 10YR to 5G occurs in the lower part. The C horizon is heavy loam to clay. In places thin lenses or pockets of gravelly material that is up to 40 percent gravel occur below a depth of about 36 inches.

Crooked Creek clay loam, 1 to 3 percent slopes (CrA).—This soil is mainly on stream terraces near the streams. It has the profile described as representative of the series. Runoff is very slow, and the hazard of erosion is slight. Included in mapping are small areas of soil that has a peaty surface layer and of better drained soils that have water tables deeper than 20 inches.

The soil is used mainly for meadow hay and pasture. Most places lack suitable drainage outlets, making drainage difficult. If drained, this soil will grow irrigated alfalfa and small grain. Capability unit IVw–35 irrigated; wildlife group 2222–I.

Crooked Creek clay loam, 3 to 10 percent slopes (CrC).—This soil is mainly in seep areas on alluvial fans below irrigation ditches and springs. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are areas that have water tables deeper than 20 inches.

The soil is used mainly for meadow hay and pasture. Drainage is difficult. Capability unit IVw–35 irrigated; wildlife group 2222–I.

Cudahy Variant

The Cudahy variant consists of poorly drained soils. These soils formed on benches and terraces in mixed alluvium over travertine bedrock or lime-cemented hardpans. Slopes range from 0 to 3 percent. The elevation ranges from 5,300 to 5,700 feet. The vegetation is mainly sedges, tules, timothy, redtop, clover, foxtail, and willows. The average annual precipitation is 16 to 19 inches, the mean annual air temperature is about 46° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is light brownish-gray and grayish-brown silt loam about 9 inches thick. The substratum is light-gray clay loam and silty clay loam about 17 inches thick. It is underlain by a platy lime-cemented hardpan at a depth of about 26 inches. The soil is moderately alkaline.

Cudahy soils are moderately permeable. The available water capacity is 2 to 4 inches depending on the depth of soils. The water table commonly fluctuates between depths of 10 and 20 inches. Roots can penetrate to a depth of 6 to 30 inches.

These soils are used for meadow hay and pasture.

Representative profile of Cudahy silt loam, cold variant, about 2 miles north of Midway, 1,820 feet north and 750 feet west of southeast corner of sec. 27, T. 3 S., R. 4 E. Laboratory data available.

O2—2 inches to 0, sod, live roots, and partly decomposed vegetation.

A11—0 to 4 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; slightly hard, friable, nonsticky and nonplastic; many fine and medium roots; very strongly calcareous; moderately alkaline; clear, smooth boundary.

A12—4 to 9 inches, grayish-brown (2.5Y 5/2) silt loam, very dark grayish brown (2.5Y 3/2) moist; moderate, fine, granular structure; slightly hard, firm, nonsticky and slightly plastic; many fine and medium roots; very strongly calcareous; moderately alkaline; clear, smooth boundary.

C1—9 to 16 inches, light-gray (2.5Y 6/1) clay loam, dark gray (2.5Y 4/1) moist; massive; slightly hard, very firm, slightly sticky and slightly plastic; many fine and medium roots; very strongly calcareous; few, fine and medium, strongly cemented lime concretions; moderately alkaline; clear, wavy boundary.

C2—16 to 23 inches, light-gray (5Y 7/1) silty clay loam, gray (5Y 5/1) moist; massive; slightly hard, very firm, slightly sticky and slightly plastic; common fine roots; very strongly calcareous; many, fine and medium, strongly cemented lime concretions; moderately alkaline; abrupt, wavy boundary.

C3—23 to 26 inches, light-gray (5Y 7/1) heavy silty clay loam, gray (5Y 5/1) moist; massive; few fine roots; very strongly calcareous; strongly cemented; moderately alkaline; abrupt, wavy boundary.

C4cam—26 to 30 inches, platy, indurated lime hardpan.

Depth of the soil above the lime-cemented hardpan ranges from 6 to 30 inches but is mainly 12 to 24 inches. The A1 horizon has value of 5 or 6 when dry and 3 or 4 when moist and has chroma of 1 or 2. It is 6 to 13 inches thick. The C horizon has hue of 2.5Y and 5Y, value of 6 to 8 when dry and 4 to 6 when moist, and chroma of 0 to 1. It ranges from clay loam to heavy silty clay loam that is 30 percent lime concretions. This horizon may not be present in the shallower areas.

Cudahy silt loam, cold variant (Cv).—This soil is mainly on wet terraces adjacent to the streams. It has the profile described as representative of the series. Slopes range from 0 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Most roots are above a depth of 12 to 24 inches. Included in mapping are areas of Rock land, travertine, and pockets of deeper soils. Most of the acreage is in meadow hay and pasture. Capability unit Vw–43 irrigated; Semi-wet Meadows range site; wildlife group 2222–I.

Cudahy silt loam, cold variant, moderately deep water table (Cw).—This soil is mainly on stream terraces. It has a profile similar to the one described as representative of the series, but the water table fluctuates between depths of 20 and 36 inches. The water table is high mainly during the irrigation season and is commonly at the contact with the travertine bedrock (fig. 3) or lime-cemented hardpan. Slopes range from 0 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Soil blowing is not a hazard. Most roots are above a depth of 30 inches. Included in mapping are small areas of Rock land.

Most of the acreage is in irrigated pasture and meadow hay. Capability unit IVe–33 irrigated; wildlife group 3242–I.

Daybell Series

The Daybell series consists of somewhat excessively drained, very gravelly soils. These soils formed mainly on north-facing mountainsides in colluvium derived from mixed sedimentary rocks. Slopes range from 25 to 65 percent. The elevation ranges from 7,000 to 8,500 feet. The vegetation is mainly an overstory of aspen and scattered spruce, fir, and maple. The understory is snowberry, ninebark, mountain bromegrass, and horsemint. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 40° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is very dark grayish-brown and dark grayish-brown loam about 16 inches thick. The substratum extends to a depth of 90 inches or more. The upper 44 inches is light brownish-gray and light gray very gravelly loamy fine sand and very gravelly fine sand. The lower part is very pale brown and light yellowish-brown cobbly fine sand and very cobbly loamy fine sand. The soil is neutral in reaction throughout.

Daybell soils are rapidly permeable. The available water capacity is about 5 inches. The water-supplying capacity is about 14 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as summer range for livestock and wildlife. They also serve as important catchment areas for water and provide sites for recreation.

Representative profile of Daybell loam in an area of Daybell-Fitzgerald association, very steep, about 20 miles southwest of Heber, 1,600 feet north and 1,720 feet east of southwest corner of sec. 1, T. 5 S., R. 5 E., in a grazable woodland area. Laboratory data available.

A11—0 to 4 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 1/3) moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many fine roots; neutral; clear, wavy boundary.

A12—4 to 16 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/3) moist; moderate, fine, granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium and few large roots; neutral; abrupt, irregular boundary.

C1—16 to 25 inches, light brownish-gray (10YR 6/2) very gravelly loamy fine sand, brown (10YR 4/3) moist; single grained but pockets of soil have weak, medium, subangular blocky structure; loose, very friable, nonsticky and nonplastic; many fine and medium roots; common medium pores; 65 percent gravel and cobbles; a few voids larger than 1 millimeter not filled with fines; neutral; clear, irregular boundary.

C2—25 to 31 inches, light brownish-gray (10YR 6/2) very gravelly loamy fine sand, brown (10YR 4/3) moist; weak, medium, subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; common medium pores; 60 per-

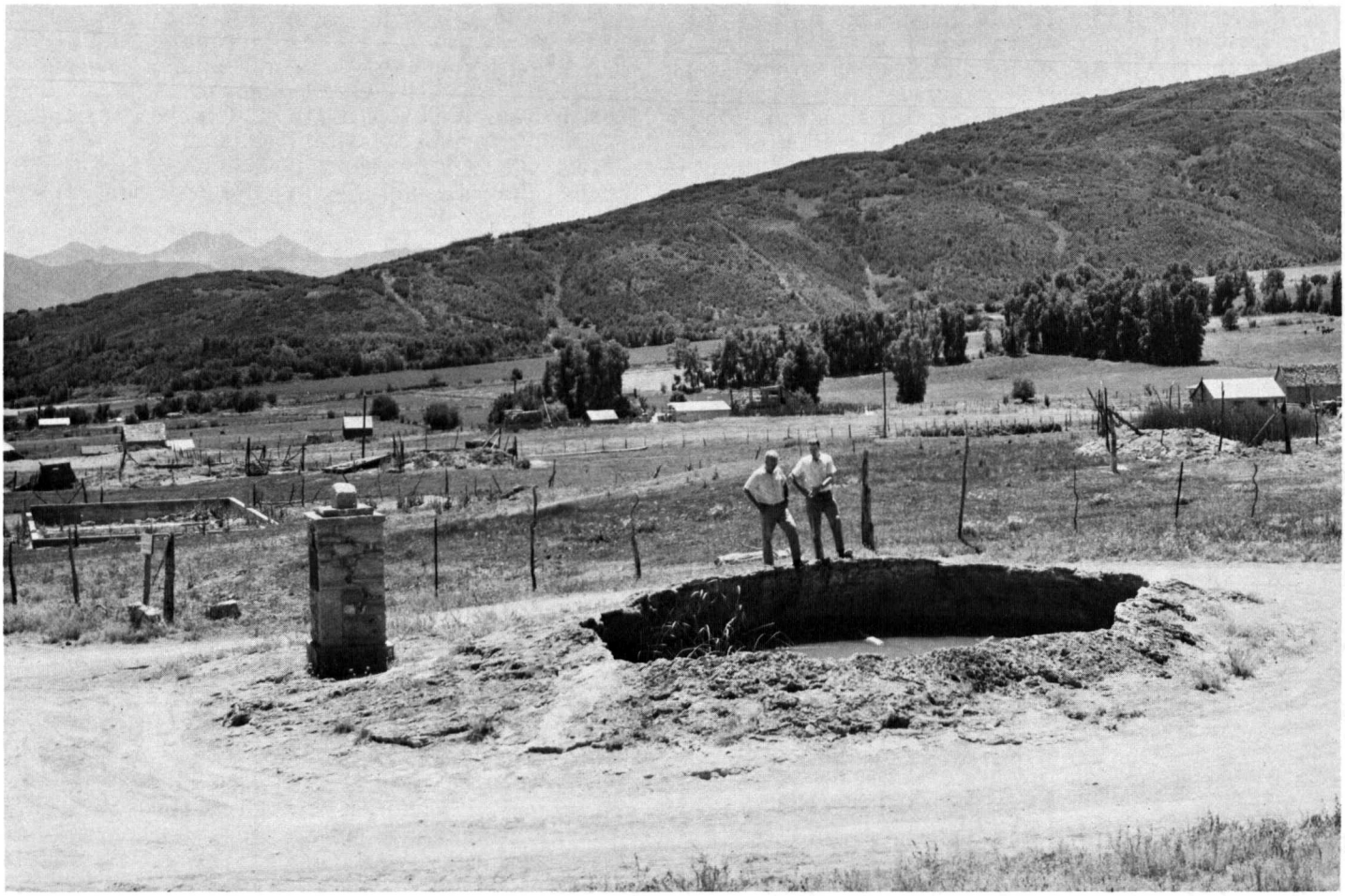

Figure 3.—**Travertine cone. The water level of the hot spring in the center of the cone is about 3 feet from the top of the cone. The Cudahy cold variant is in the wet meadow adjacent to the cone.**

cent gravel and cobbles; a few voids larger than 1 millimeter not filled with fines; neutral; clear, irregular boundary.

C3—31 to 51 inches, light brownish-gray (10YR 6/2) very gravelly fine sand, brown (10YR 4/3) moist; single grained; loose, very friable, nonsticky and nonplastic; common fine roots concentrated in the soil and on gravel faces; 75 percent gravel, cobbles, and stones; common voids 1 millimeter or larger not filled with fines; neutral; clear, wavy boundary.

C4—51 to 60 inches, light-gray (10YR 7/2) very gravelly loamy fine sand, brown (10YR 5/3) moist; single grained; loose, very friable, nonsticky and nonplastic; few fine roots; 75 percent gravel, cobbles, and stones; common voids 1 millimeter or larger not filled with fines; neutral; clear, wavy boundary.

C5—60 to 76 inches, very pale brown (10YR 7/3) very cobbly fine sand, yellowish brown (10YR 5/4) moist; single grained; loose, nonsticky and nonplastic; few fine roots; 80 percent gravel, cobbles, and stones; common voids 1 millimeter or larger not filled with fines; neutral; diffuse, irregular boundary.

C6—76 to 90 inches, light yellowish-brown (10YR 6/4) very cobbly loamy very fine sand, yellowish brown (10YR 5/5) moist; single grained; soft, very friable, nonsticky and nonplastic; few fine roots; 80 percent gravel, cobbles, and stones; common voids 1 millimeter or larger not filled with fines; neutral.

The A1 horizon has value of 3 to 5 when dry and 1 to 3 when moist and has chroma of 2 or 3. It is 16 to 24 inches thick. The C horizon has hue of 10YR or 7.5YR, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 2 to 4.

Daybell-Fitzgerald association, very steep (DAF).—This mapping unit is on northerly exposures of the higher mountains. It is about 30 percent Daybell loam, 30 percent Daybell gravelly loam, and 40 percent Fitzgerald gravelly loam, all of which have slopes of 40 to 65 percent. The Daybell soils are in the aspen areas, and the Fitzgerald soils are in the spruce-fir areas. Daybell loam has the profile described as representative of the series. Daybell gravelly loam has a similar profile except the surface layer is 20 to 50 percent gravel. Fitzgerald gravelly loam has the profile described as representative of the Fitzgerald series. Runoff is rapid, and the hazard of erosion is high. Included in mapping are small areas of Roundy soils and small areas that have a cobbly surface layer.

These soils are used mainly as summer range for livestock and wildlife and for recreation. The Fitzgerald soil is used for woodland. Both serve as important catchment areas for water. Daybell soils in capability unit VIIs–H nonirrigated, High Mountain Stony Loam (Aspen) range site, wildlife group 3141; Fitzgerald soil in capability unit VIIe–HC nonirrigated, woodland, wildlife group 3141.

Daybell soils, 25 to 40 percent slopes (DBE).—This

mapping unit is on the lower high mountainsides, generally in side canyons that extend from the main canyons. It is about 50 percent Daybell loam and 50 percent Daybell gravelly loam, both of which have slopes of 25 to 40 percent. These soils are intermingled, and either soil may dominate in a given area. These soils have profiles similar to the one described as representative of the series, except the surface layer of Daybell gravelly loam is 20 to 50 percent gravel. Runoff is medium, and the hazard of erosion is moderate. Included with this unit in mapping are small areas of Roundy and Fitzgerald soils and areas of soils that have a cobbly surface layer.

This mapping unit is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIs–H nonirrigated; High Mountain Stony Loam (Aspen) range site; wildlife group 3141.

Daybell soils, 40 to 65 percent slopes (DBF).—This mapping unit is mainly on northerly exposures of the higher mountainsides. It is about 45 percent Daybell loam and 45 percent Daybell gravelly loam, both of which have slopes of 40 to 65 percent, and about 10 percent other soils. These soils are intermingled, and either soil can dominate in a given area. Daybell loam has the profile described as representative of the series. Daybell gravelly loam has a similar profile, but the surface layer is 20 to 50 percent gravel. Runoff is rapid, and the hazard of erosion is high. Included in mapping are small areas of Fitzgerald soils and soils that have a cobbly surface layer.

This mapping unit is used mainly as summer range for livestock, catchment areas for water, and sites for recreation. Capability unit VIIs–H nonirrigated; High Mountain Stony Loam (Aspen) range site; wildlife group 3141.

Deer Creek Series

The Deer Creek series consists of well-drained soils. These soils formed on alluvial fans and the lower mountainsides in alluvium and residuum derived mainly from mixed sedimentary rocks. Slopes range from 1 to 25 percent. The elevation ranges from 5,500 to 6,500 feet. The vegetation is mainly oakbrush, big sagebrush, bluebunch wheatgrass, bitterbrush, serviceberry, and native bluegrasses. The average annual precipitation is 16 to 18 inches, the annual air temperature is about 45° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is dark-grayish brown loam and gravelly loam about 10 inches thick. The subsoil is about 24 inches thick. The upper 4 inches is dark grayish-brown gravelly clay loam. The lower 20 inches is reddish-brown gravelly clay. The substratum is very pale brown and white cobbly clay loam that extends to a depth of 60 inches. The soil is neutral in the surface layer, neutral and slightly acid in the subsoil, and mildly alkaline in the substratum.

Deer Creek soils are slowly permeable. The available water capacity is about 7 inches. The water-supplying capacity is 10 to 12 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as spring and fall range for livestock, for wildlife, and for irrigated alfalfa and small grain. They also serve as catchment areas for water and provide sites for recreation.

Representative profile of Deer Creek loam in an area of Deer Creek-Watkins Ridge complex, 15 to 25 percent slopes, 0.1 mile north of Wallsburg Junction and U.S. Highway 189, and 0.9 mile east on side road; 1,460 feet east and 1,080 feet north of the southwest corner of sec. 35, T. 4 S., R. 4 E. in an area of range. Laboratory data available.

A11—0 to 3 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, thick, platy structure parting to weak, fine, granular; slightly hard, friable, nonsticky and slightly plastic; common fine roots; many medium vesicular pores; 10 percent gravel; neutral; abrupt, wavy boundary.

A12—3 to 10 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; weak, coarse and medium, subangular blocky structure parting to moderate, fine, subangular blocky; slightly hard, friable, nonsticky and plastic; many fine and medium roots; common fine pores; 20 percent gravel; abrupt, wavy boundary.

B1—10 to 14 inches, dark grayish-brown (10YR 4/2) gravelly clay loam, dark brown (10YR 3/3) moist; moderate, medium and coarse, subangular blocky structure parting to moderate, fine, angular blocky; very hard, firm, sticky and plastic; common fine and medium roots; few fine pores; clay films as bridging between sand grains; 20 percent gravel; neutral; abrupt, wavy boundary.

B2t—14 to 34 inches, reddish-brown (5YR 5/4) gravelly clay, dark reddish brown (5YR 3/4) moist; strong, medium and fine, angular blocky structure; extremely hard, very firm, very sticky and very plastic; common fine and few medium roots; few fine pores; thick, continuous clay films in channels and on peds; 40 percent gravel; slightly acid; diffuse boundary.

C1ca—34 to 46 inches, very pale brown (10YR 7/3) cobbly clay loam, very pale brown (10YR 7/4) moist; massive; very hard, firm, sticky and plastic; few fine roots; very strongly calcareous; weakly cemented with some laminae; 30 percent gravel and cobbles; mildly alkaline; clear, wavy boundary.

C2ca—46 to 60 inches, white (10YR 8/2) cobbly clay loam, very pale brown (10YR 8/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; very strongly calcareous, some weakly cemented laminae; 20 percent gravel and cobbles; mildly alkaline.

The A1 horizon has value of 3 or 4 when dry and 2 or 3 when moist and has chroma of 2. It is 7 to 14 inches thick. The B2t horizon has hue of 5YR or 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It ranges from clay to heavy clay loam and is 20 to 35 percent gravel and cobbles. It is 14 to 30 inches thick. The Cca horizon has hue of 10YR or 5YR, value of 6 to 8 when dry and 5 to 8 when moist, and chroma of 3 to 6. It ranges from clay loam to loam and is 20 to 60 percent gravel and cobbles that increase with increasing depth. This horizon extends to a depth of 60 inches or more.

Deer Creek loam, 1 to 3 percent slopes (DcA).—This soil is mainly on alluvial fans. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of Manila soils.

Most of the acreage is in irrigated alfalfa and small grain. Capability unit IIIc–3 irrigated; wildlife group 2141–I.

Deer Creek loam, 3 to 10 percent slopes (DcC).—This soil is mainly on alluvial fans next to mountain foot slopes. Runoff is moderately rapid, and the hazard of erosion is high in irrigated areas. Included in mapping are small areas of Manila silt loam, 6 to 10 percent slopes.

Most of the acreage is used for irrigated alfalfa,

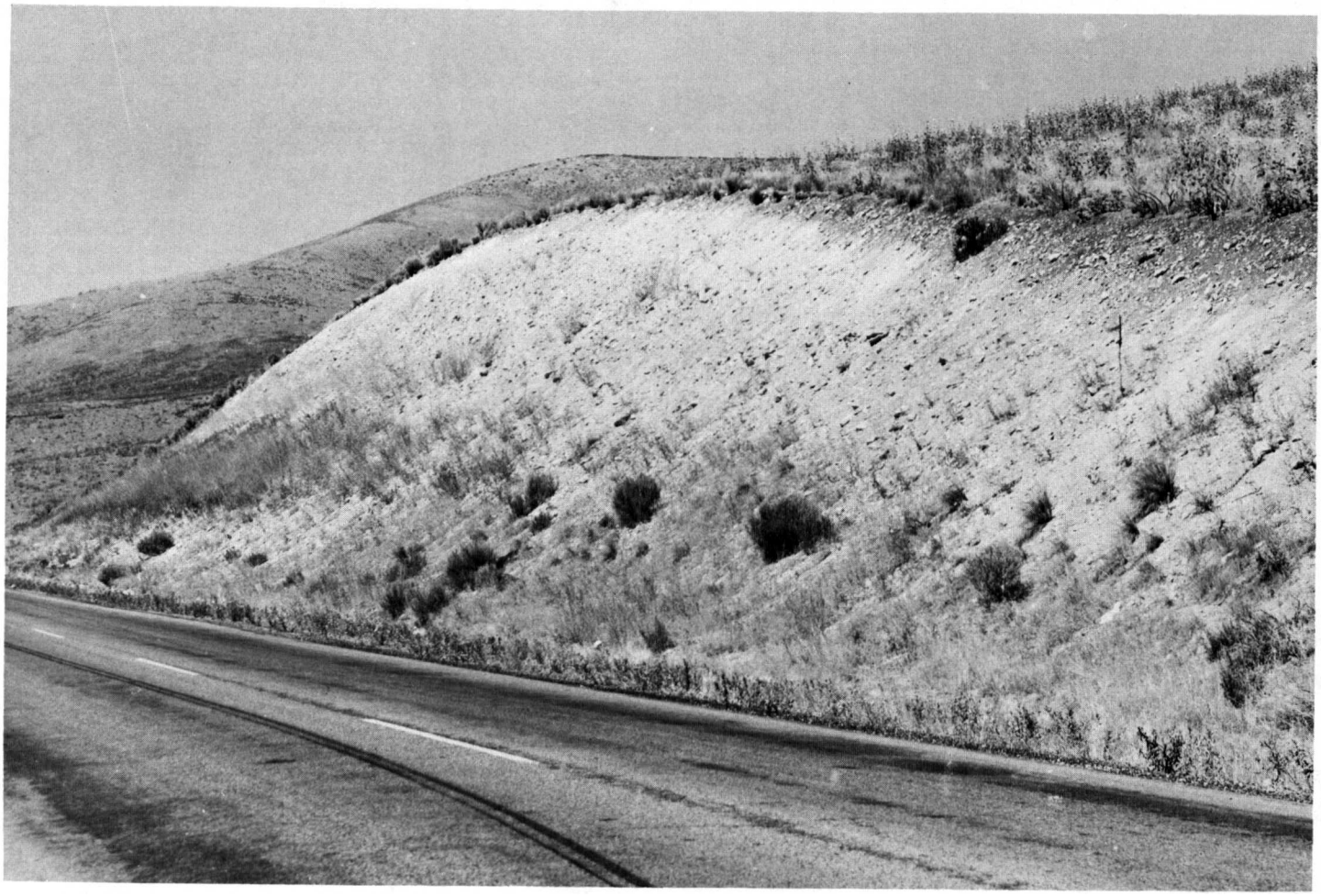

Figure 4.—Road cut through the Deer Creek-Watkins Ridge complex.

pasture, and small grain. Capability unit IIIe–3 irrigated; wildlife group 2141–I.

Deer Creek-Watkins Ridge complex, 6 to 15 percent slopes (DWC).—This mapping unit is on alluvial fans and the lower mountainsides mainly adjacent to the valleys. It is about 50 percent Deer Creek loam, 10 to 15 percent slopes; 35 percent Watkins Ridge silt loam, 6 to 15 percent slopes; and about 15 percent other soils. The Deer Creek soil is mainly in the swales (fig. 4) and concave areas. The Watkins Ridge soil is on the ridges, knolls, and convex areas. Runoff is slow, and the hazard of erosion is slight.

Included with this unit in mapping are small areas of Deer Creek soils that have slopes of less than 10 percent, soils that have a surface layer of cobbly loam, and intermingled small tracts of Bezzant soils.

This mapping unit is used mainly as spring and fall range for livestock and wintering areas for wildlife, mainly deer. It serves as a catchment area for water and provides sites for recreation. Capability unit VIe–U nonirrigated; Upland Loam range site; wildlife group 2141.

Deer Creek-Watkins Ridge complex, 15 to 25 percent slopes (DWD).—This mapping unit is on alluvial fans and mountain foot slopes. It is about 50 percent Deer Creek loam and 35 percent Watkins Ridge silt loam, both of which have slopes of 15 to 25 percent, and about 15 percent other soils. The Deer Creek soil is mainly in the concave areas, and the Watkins Ridge soil is on the ridges and in convex areas. Deer Creek loam has the profile described as representative of the series. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are small areas that have a cobbly surface layer and some areas of Bezzant soils.

This mapping unit is used mainly as spring and fall range for livestock and wintering areas for wildlife, mainly deer. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe–U nonirrigated; Upland Loam range site; wildlife group 2141.

Fitzgerald Series

The Fitzgerald series consists of somewhat excessively drained, very gravelly soils. These soils formed on north-facing sides of the higher mountains in colluvium derived from mixed sedimentary rocks. Slopes range from 40 to 65 percent. The elevation

ranges from 6,300 to 7,900 feet. The vegetation is mainly Douglas-fir, Alpine fir, and white fir and some aspen. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 39° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is very dark grayish-brown and grayish-brown gravelly loam about 9 inches thick. The subsurface layer is light brownish-gray gravelly sandy loam about 17 inches thick. The subsoil extends to a depth of 60 inches. The upper 19 inches is brown very gravelly light sandy clay loam. The lower part is light yellowish-brown very gravelly sandy loam. The soil is slightly acid throughout.

Fitzgerald soils are moderately permeable. The available water capacity is about 4 inches. The water-supplying capacity is 10 to 13 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used for woodland and wildlife habitat. They also serve as catchment areas for water and provide sites for recreation. Fitzgerald soils are mapped only with Daybell soils.

Representative profile of Fitzgerald gravelly loam, in an area of Daybell-Fitzgerald association, very steep, 11.2 miles southeast of Heber, 1,000 feet south and 320 feet west of the northeast corner of sec. 32, T. 4 S., R. 6 E., in an area of woodland:

O1—2 inches to 0, needle litter.

A11—0 to 3 inches, very dark grayish-brown (10YR 3/2) gravelly loam, very dark brown (10YR 2/2) moist; weak, medium, granular structure; slightly hard, very friable, nonsticky and nonplastic; many fine and few medium and large roots; slightly acid; abrupt, wavy boundary.

A12—3 to 9 inches, grayish-brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak, coarse and fine, subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many fine and few medium and large roots; thin, patchy gray coatings on some peds; slightly acid; clear, wavy boundary.

A2—9 to 26 inches, light brownish-gray (10YR 6/2) gravelly sandy loam, brown (10YR 5/3) moist; single grained; loose, very friable, nonsticky and nonplastic; many fine and few medium and large roots; vesicular pores; 50 percent angular gravel; slightly acid; abrupt, irregular boundary.

B&A—26 to 45 inches, B2t part (about 80 percent) is brown (10YR 5/3) very gravelly light sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak, coarse, blocky structure parting to fine blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium and few large roots; common fine pores; common thin clay films on peds and in pores; 70 percent angular gravel; slightly acid; clear, wavy boundary. The A2 part occurs as tongues and gray coatings on some B2t peds and coarse fragments.

B3—45 to 60 inches, light yellowish-brown (10YR 6/4) very gravelly sandy loam, yellowish brown (10YR 5/4) moist; weak, fine, subangular blocky structure; loose, very friable, nonsticky and nonplastic; few fine roots; 80 percent angular gravel; slightly acid.

The A1 horizon has value of 3 to 5 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 6 to 9 inches thick. The A2 horizon has value of 5 to 7 when dry and 4 to 5 when moist and has chroma of 2 or 3. It ranges from gravelly sandy loam to very cobbly sandy loam. It is 9 to 16 inches thick. The B2t horizon has hue of 10YR or 7.5YR, value of 5 or 6 when dry and 4 or 5 when moist, and chroma of 3 or 4. It ranges from very gravelly sandy clay loam to very gravelly or very cobbly loam. It is 18 to 30 inches thick. Content of gravel increases to as much as 80 percent below a depth of about 40 inches.

Fluventic Haploborolls

Fluventic Haploborolls (FA) consists of intermixed soils along stream bottoms in the valleys and narrow canyons. These soils are generally dissected by numerous stream channels. They ordinarily have a loamy surface layer 6 to 15 inches thick over loose gravel, but the texture varies significantly within very short distances. In many places the surface layer is cobbly or gravelly or very cobbly or stony. Slopes are mainly 1 to 6 percent, but range to 10 percent on the alluvial fans at the mouths of the steep side tributaries to the main canyons. The water table fluctuates with the streamflow, normally between 2 and 5 feet, and many areas are flooded for short periods in most years. The vegetation is cottonwood, willows, hawthorn, and an understory of grasses, forbs, and shrubs. The elevation ranges from 5,400 to 7,200 feet. The average annual precipitation is 16 to 25 inches, the mean annual air temperature is 42° to 46° F, and the frost-free period ranges from about 50 days at the higher elevations to 90 days in the lower valleys. Runoff is slow to medium. The hazard of erosion is slight except for some streambank erosion during periods of high water.

Included in the mapping are areas of deep loamy alluvial soils, which make up about 20 percent of the unit, and small seep areas where the water table is at or near the surface.

Fluventic Haploborolls produce meadow hay in places, but mostly they are used as range for livestock and wildlife, as woodland, and for recreation. Use should be determined as needed at each individual location. Capability unit VIw–4 irrigated; Wet Stream Bottoms range site; wildlife group 2131–I.

Flygare Series

The Flygare series consists of well-drained soils. These soils formed mainly on lateral moraines of the higher mountains in glacial drift derived from andesite. Slopes range from 3 to 60 percent. The elevation ranges from 7,300 to 8,300 feet. The vegetation is mainly aspen and an understory of chokecherry, snowberry, mountain bromegrass, slender wheatgrass, peavine, and bluebells. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 38° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is about 27 inches thick. The upper 17 inches is brown sandy loam and loam. The lower 10 inches is brown very cobbly loam. The subsurface layer is yellowish-brown very cobbly sandy loam about 9 inches thick. The subsoil is brown cobbly light sandy clay loam and light-brown cobbly heavy sandy loam about 14 inches thick. The substratum is pinkish-gray very cobbly sandy loam that extends to a depth of 70 inches. The soil is medium acid in the top 36 inches and strongly acid below to a depth of 70 inches.

Flygare soils are moderately permeable. The available water capacity is about 7 inches. The water-supplying capacity is 16 to 18 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as summer range for livestock and wildlife and as woodland. They also serve as

catchment areas for water and provide sites for recreation.

Representative profile of Flygare loam, 6 to 15 percent slopes, about 17 miles east of Heber in the NW¼ of sec. 13, T. 4 S., R. 6 E. in a grazable woodland area. Laboratory data available.

A11—0 to 2 inches, dark-brown (10YR 3/3) loam, very dark brown (10YR 2/2) moist; weak, medium, granular structure; loose, very friable, nonsticky and slightly plastic; many fine, medium, and large roots; slightly acid; abrupt, wavy boundary.

A12—2 to 10 inches, brown (10YR 4/3) sandy loam, very dark brown (10YR 2/3) moist; weak, medium, granular structure; loose, very friable, slightly sticky and slightly plastic; common fine, medium, and large roots; medium acid; clear, wavy boundary.

A13—10 to 17 inches, brown (10YR 4/3) loam, very dark brown (10YR 2/3) moist; weak, coarse, subangular blocky structure parting to moderate, medium, granular; slightly hard, firm, slightly sticky and slightly plastic; common fine, medium, and large roots; common fine and medium pores; medium acid; abrupt, wavy boundary.

A14—17 to 27 inches, brown (10YR 4/3) very cobbly loam, very dark brown (10YR 2/3) moist; weak, medium, subangular blocky structure parting to moderate, fine and medium, granular; soft, friable, slightly sticky and slightly plastic; common fine, medium, and large roots; 70 percent gravel, cobbles, and stones; medium acid; clear, irregular boundary.

A2—27 to 36 inches, yellowish-brown (10YR 5/4) very cobbly sandy loam, dark yellowish brown (10YR 3/4) moist; moderate, coarse, subangular blocky structure parting to fine and medium blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; common medium pores; 70 percent gravel, cobbles, and stones; medium acid; clear, smooth boundary.

B2t—36 to 41 inches, brown (7.5YR 5/4) cobbly light sandy clay loam, dark brown (7.5YR 3/4) moist; moderate, coarse, subangular blocky structure parting to fine, subangular blocky; hard, firm, sticky and plastic; common fine and medium and few large roots; common fine pores; common, moderately thick clay films on peds; thin, continuous clay films on sand grains; 40 percent gravel and cobbles; strongly acid; clear, wavy boundary.

B3—41 to 50 inches, light-brown (7.5YR 6/3) cobbly heavy sandy loam, dark brown (7.5YR 4/4) moist; moderate, coarse, subangular blocky structure parting to fine, subangular blocky; hard, firm, sticky and plastic; common fine and medium and few large roots; common fine pores; 45 percent gravel and cobbles; few, thin clay films on peds and sand grains; strongly acid; gradual, wavy boundary.

C—50 to 70 inches, pinkish-gray (7.5YR 6/2) very cobbly sandy loam, brown (7.5YR 4/3) moist; weak, coarse, subangular blocky structure parting to fine, subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium and few large roots; common fine pores; 50 percent cobbles; few thin clay films on some ped faces and sand grains and in some pores; strongly acid.

The A1 horizon has value of 3 to 5 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 20 to 27 inches thick. The A2 horizon has value of 5 or 6 when dry and 3 or 4 when moist and has chroma of 2 or 4. It is cobbly or very cobbly light loam to sandy loam. It is 2 to 12 inches thick. The B2t horizon has hue of 10YR or 7.5YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 to 4. It ranges from sandy clay loam to heavy sandy loam that is 35 to 50 percent cobbles. It is 5 to 20 inches thick.

Flygare loam, 3 to 6 percent slopes (FBB).—This soil is mainly in aspen-covered areas of the high plateau between Lake Creek and the Provo River. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of steeper Flygare soils and Clayburn soils in small grassy parks.

This soil is used mainly as summer range for livestock and wildlife and as sites for summer homesites. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Flygare loam, 6 to 15 percent slopes (FBC).—This soil is mainly in the aspen-covered areas of the high plateau between Lake Creek and the Provo River. It has the profile described as representative of the series. The hazard of erosion is slight.

Included with this soil in mapping are open-park areas with cobbly surfaces and areas of Clayburn loam and Flygare soils that are flatter and slightly steeper.

This soil is used mainly as summer range for livestock and wildlife and as sites for summer homes. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Flygare loam, 15 to 25 percent slopes (FBD).—This soil is mainly in the more sloping aspen-covered areas of the high plateau between Lake Creek and the Provo River. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are small tracts of less sloping Flygare soils and Clayburn soils in small park areas.

This soil is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Flygare-Little Pole association, hilly (FLD).—This mapping unit is on the northerly exposures of mountainsides near the edge of high plateaus. It is about 70 percent Flygare loam, 15 to 25 percent slopes; 20 percent Little Pole very cobbly sandy clay loam, 6 to 25 percent slopes; and about 10 percent other soils. The Flygare soil is mainly in the aspen-covered depressions and swales where the glacial drift is thickest. The Little Pole soil is scattered throughout the area on the rocky knolls and ridges that have grass and shrub vegetation. The Little Pole soil has slopes of dominantly 15 to 25 percent. Runoff is medium, and the hazard of erosion is moderate.

Included with this soil in mapping are areas of less sloping Flygare soils, some Rock outcrop, and areas of Flygare soil where the surface layer is 20 to 50 percent cobbles.

This mapping unit is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Flygare soil in capability unit VIe–H nonirrigated, High Mountain Loam (Aspen) range site, wildlife group 3141; Little Pole soil in capability unit VIIs–M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343.

Flygare-Little Pole association, steep (FLE).—This mapping unit is mainly on the north exposures of the steep canyons and tributaries that dissect high mountain plateaus. It is about 70 percent Flygare loam and 20 percent Little Pole very cobbly sandy

clay loam, both of which have slopes of 25 to 40 percent, and about 10 percent other soils. The Flygare soil is in areas of aspen where the glacial drift is thickest. The Little Pole soil is on the grass- and shrub-covered rocky knolls and ridges that are scattered throughout the unit. Runoff is rapid, and the hazard of erosion is moderate.

Included with this unit in mapping are Rock outcrop and areas of Flygare soil where the surface layer is 20 to 50 percent cobbles.

This mapping unit is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Flygare soil in capability unit VIe–H nonirrigated, High Mountain Loam (Aspen) range site, wildlife group 3141; Little Pole soil in capability unit VIIs–M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343.

Flygare soils, 25 to 40 percent slopes (FRE).—This mapping unit is mainly in the steep canyons and their tributaries that dissect high mountain plateaus. It is about 60 percent Flygare loam and 30 percent Flygare cobbly loam, both of which have slopes of 25 to 40 percent, and about 10 percent other soils. These soils are intermingled, and either soil can dominate in a given area. These soils have profiles similar to the one described as representative of the series, but the surface layer of Flygare cobbly loam is 20 to 50 percent cobbles. Runoff is rapid, and the hazard of erosion is moderate.

Included with this unit in mapping are small areas of Baird Hollow loam, 25 to 40 percent slopes.

This mapping unit is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Flygare soils, 40 to 60 percent slopes (FRF).—This mapping unit is in the canyons and their tributaries that dissect the high mountain plateau northeast of Heber City. It is about 65 percent Flygare loam and about 35 percent Flygare cobbly loam, both of which have slopes of 40 to 60 percent. These soils are intermingled, and either soil can dominate in a given area. Both soils have profiles similar to the one described as representative of the series, but the surface layer of Flygare cobbly loam is 20 to 50 percent cobbles. Runoff is rapid, and the hazard of erosion is high.

This mapping unit is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Flygare Variant

The Flygare variant consists of well-drained, cobbly soils. These soils formed on mountainsides in glacial drift derived mainly from andesite. Slopes range from 6 to 40 percent. The elevation ranges from 8,500 to 9,200 feet. The vegetation is mainly Engelmann spruce, Alpine fir, and some aspen. The understory is meadowrue, Jacobs ladder, and sedges. The average annual precipitation is 30 to 35 inches, the mean annual air temperature is about 37° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is dark grayish-brown coarse sandy loam and gravelly sandy loam about 26 inches thick. The subsurface layer is light brownish-gray cobbly sandy loam about 35 inches thick. The subsoil is pale-brown cobbly fine sandy loam that extends to a depth of 85 inches. The soil is mostly medium acid but is slightly acid between depths of 26 and 61 inches.

These soils are moderately permeable. The water-supplying capacity is 14 to 16 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as woodland and wildlife habitat. They also serve as catchment areas for water and provide sites for recreation.

Representative profile of Flygare coarse sandy loam in an area of Flygare soils, sandy loam subsoil variant, 25 to 40 percent slopes, about 17 miles southeast of Heber, 3,680 feet west and 1,120 feet north of the southeast corner of sec. 36, T. 4 S., R. 6 E. in an area of woodland. Laboratory data available.

O1—½ inch to 0, forest litter.

A11—0 to 9 inches, dark grayish-brown (10YR 4/2) coarse sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; loose, very friable, nonsticky and nonplastic; many fine and common medium roots; medium acid; clear, wavy boundary.

A12—9 to 26 inches, dark grayish-brown (10YR 4/2) gravelly sandy loam, very dark brown (10YR 2/2) moist; weak, fine, subangular blocky structure parting to weak, medium, granular; soft, very friable, nonsticky and slightly plastic; common fine and medium roots; 20 percent gravel and cobbles; clear, wavy boundary.

A2—26 to 44 inches, light brownish-gray (10YR 6/2) cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and slightly plastic; common fine and medium roots; 45 percent cobbles and gravel; slightly acid; clear, broken boundary.

A&B—44 to 61 inches, 75 percent like the A2 horizon and 25 percent like the B2t horizon; 45 percent cobbles and gravel; abrupt, irregular boundary.

B2t—61 to 85 inches, pale-brown (10YR 6/3) cobbly fine sandy loam, dark brown (10YR 3/3) moist; moderate, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; hard, firm, slightly sticky and plastic; few fine and medium roots; common fine and medium pores; common, thin clay films on peds and in pores; 45 percent cobbles and gravel; medium acid.

The A1 horizon has value of 4 to 5 when dry and 2 or 3 when moist and has chroma of 2. It is 20 to 27 inches thick. The A2 horizon has value of 5 or 6 when dry and 3 or 4 when moist and has chroma of 2. It is 10 to 18 inches thick. The B2t horizon has value of 5 or 6 when dry and 3 or 4 when moist and has chroma of 2 or 4. It ranges from loam to sandy loam that is 30 to 50 percent cobbles and gravel.

Flygare soils, sandy loam subsoil variant, 25 to 40 percent slopes (FSE).—This mapping unit is on northerly mountainsides. It is about 45 percent each Flygare coarse sandy loam and Flygare cobbly coarse sandy loam, both of which are sandy loam subsoil variants and have slopes of 25 to 40 percent; and about 10 percent other soils. These soils are intermingled, and either soil may dominate in a given area. Flygare coarse sandy loam, sandy subsoil variant, in this mapping unit has the profile described as representative of the variant. The Flygare cobbly coarse sandy loam has a profile similar to the one described as representative

of the series, but the surface layer is cobbly. Runoff is medium, and the hazard of erosion is moderate.

Included with this unit in mapping are areas of Rock outcrop and areas of soils that have slopes of 40 to 60 percent.

This mapping unit is used mainly as woodland and wildlife habitat. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe-HC nonirrigated; woodland; wildlife group 3141.

Gappmayer Series

The Gappmayer series consists of well-drained gravelly or cobbly soils. These soils formed on northerly exposures of mountainsides in alluvium and colluvium derived from mixed sedimentary rocks. Slopes range from 15 to 65 percent. The elevation ranges from 5,500 to 7,200 feet. The vegetation is mainly oakbrush and big sagebrush, snowberry, mountain myrtle, maple, peavine, bluegrasses, and a few scattered Douglas-fir trees. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 45° F, and the frost-free period is about 50 to 70 days in nonirrigated areas and 70 to 80 days in irrigated areas.

In a representative profile the surface layer is dark grayish-brown gravelly fine sandy loam about 11 inches thick. The subsurface layer is brown and pale-brown cobbly fine sandy loam about 17 inches thick. The subsoil is reddish-brown very cobbly sandy loam about 16 inches thick. It is underlain by fractured bedrock at a depth of 44 inches. The soil is neutral to slightly acid throughout.

Gappmayer soils are moderately permeable. The available water capacity is 4 to 5 inches. The water-supplying capacity is 8 to 10 inches. Roots can penetrate to a depth of 40 inches or more.

These soils serve as a catchment area for water. They also provide spring and fall range for livestock and wildlife and sites for recreation.

Representative profile of Gappmayer gravelly fine sandy loam, 40 to 65 percent slopes, about 7 miles southeast of Heber, 1,600 feet west and 2,520 feet south of northeast corner of sec. 25, T. 4 S., R. 5 E. in an area of range. Laboratory data available.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) gravelly fine sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; loose, very friable, nonsticky and nonplastic; many fine roots; 20 percent gravel; neutral; abrupt, wavy boundary.

A12—2 to 11 inches, dark grayish-brown (10YR 4/2) gravelly fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure parting to weak, fine, granular; soft, friable, nonsticky and slightly plastic; many fine and medium roots; many fine pores; 30 percent gravel; neutral; clear, wavy boundary.

A21—11 to 21 inches, brown (10YR 5/3) cobbly fine sandy loam, dark brown (10YR 4/3) moist; weak, medium and fine, subangular blocky structure; hard, friable, slightly sticky and plastic; many fine and medium roots; common medium pores; moderate, continuous gray coatings on ped faces; 30 percent gravel and cobbles; neutral; clear, irregular boundary.

A22—21 to 28 inches, pale-brown (10YR 6/3) cobbly fine sandy loam, brown (10YR 4/3) moist; weak, medium and fine, subangular blocky structure; hard, friable, slightly sticky and plastic; many fine and common medium roots; common medium pores; moderate, continuous gray coatings on ped faces; 40 percent gravel and cobbles; neutral; abrupt, irregular boundary.

B2t—28 to 33 inches, reddish-brown (5YR 5/4) very cobbly sandy clay loam, reddish brown (5YR 4/4) moist; weak, coarse, subangular blocky structure parting to moderate, fine, angular blocky; extremely hard, very firm, sticky and very plastic; common fine roots; moderately thick, continuous clay films on peds and in pores; 65 percent angular gravel, cobbles, and stones; slightly acid; abrupt, wavy boundary.

B3—33 to 44 inches, similar to the B2t horizon, but 80 percent angular cobbles and stones.

R—44 to 54 inches, fractured bedrock that has soil material in the cracks.

The A1 horizon has value of 3 or 4 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 8 to 19 inches thick. The A2 horizon has value of 4 to 6 when dry and 3 or 4 when moist and has chroma of 2 to 4. It is 15 to 26 inches thick. It ranges from fine sandy loam to loam that is 0 to 60 percent angular gravel, cobbles, and stones. The B2t horizon has hue of 10YR to 5YR, value of 5 or 6 when dry and 3 to 5 when moist, and chroma of 3 to 6. It ranges from sandy clay loam to sandy clay that is 50 to 70 percent angular stones, cobbles, and gravel. It is 8 to 16 inches thick.

Gappmayer gravelly fine sandy loam, 15 to 25 percent slopes (GAD).—This soil is mainly on alluvial fans and terminal moraines of the mountains. Runoff is slow, and the hazard of erosion is slight in nonirrigated areas and in irrigated areas. Included in mapping are areas of soils that have slopes of 5 to 15 percent that make up about 20 percent of the acreage.

This soil provides spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. The small, less sloping areas are in irrigated alfalfa and pasture. Capability unit IVe-34 irrigated and VIe-M nonirrigated; Mountain Gravelly Loam (Oakbrush) range site; wildlife groups 3242-I irrigated and 3242 nonirrigated.

Gappmayer gravelly fine sandy loam, 40 to 65 percent slopes (GAF).—This soil is mainly on steep northerly sides of the foothills and lower mountains. It has the profile described as representative of the series. Runoff is rapid, and the hazard of erosion is high. Soil blowing is not a hazard. Included in mapping are small areas of Bradshaw, Henefer, and Wallsburg soils near the outer boundaries and small areas of Gappmayer very cobbly fine sandy loam.

The soil provides spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIIe-M nonirrigated; Mountain Gravelly Loam (Oakbrush) range site; wildlife group 3242.

Gappmayer very cobbly fine sandy loam, 40 to 65 percent slopes (GMF).—This soil is mainly on northerly sides of the lower mountains. It has a profile similar to the one described as representative of the series, but its surface layer is 50 to 70 percent cobbles and gravel. Runoff is rapid, and the hazard of erosion is high. Included in mapping are small areas of Gappmayer gravelly fine sandy loam and some areas of Bradshaw, Henefer, and Wallsburg soils.

This soil provides spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIIs-M nonirrigated; Mountain Gravelly Loam (Oakbrush) range site; wildlife group 3242.

Gappmayer-Bradshaw association, very steep (GPF).—This mapping unit is on mountainsides that are dissected by deep canyons. It is about 55 percent Gappmayer very cobbly fine sandy loam, 40 to 65 percent slopes; 35 percent Bradshaw very cobbly very fine sandy loam, 46 to 60 percent slopes; and about 10 percent other soils. The Gappmayer soil is on the northerly exposures, and the Bradshaw soil is on the southerly exposures of the steep canyons. The Gappmayer soil has a profile similar to the one described as representative of the series, but the surface layer is 50 to 70 percent cobbles. Runoff is rapid, and the hazard of erosion is high. Included in mapping are small areas of Wallsburg and Henefer soils.

This mapping unit provides spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIIs-M nonirrigated; wildlife group 3242; Gappmayer soil in Mountain Gravelly Loam (Oakbrush) range site, Bradshaw soil in Mountain Stony Loam range site.

Gappmayer-Wallsburg association, very steep (GWF).—This mapping unit is on north and east exposures of mountainsides. It is about 65 percent Gappmayer gravelly fine sandy loam, 40 to 65 percent slopes; 25 percent Wallsburg very cobbly sandy clay loan, 20 to 60 percent slopes; and about 10 percent other soils and Rock outcrop. The Gappmayer soil is in the concave areas and swales. The Wallsburg soil is on the ridges and in shallow convex areas. Runoff is rapid, and the hazard of erosion is high. Included in mapping are areas of Rock outcrop and Rock land and small areas of Henefer soils.

This mapping unit provides spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Gappmayer soil in capability unit VIIe-M nonirrigated, Mountain Gravelly Loam (Oakbrush) range site, wildlife group 3242; Wallsburg soil in capability unit VIIs-M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343.

Hailman Series

The Hailman series consists of well-drained, cobbly soils. These soils formed on ground and lateral moraines in glacial drift derived mainly from quartz-diorite porphyry. Slopes range from 6 to 60 percent. The elevation ranges from 6,500 to 8,500 feet. The vegetation is mainly aspen and an understory of snowberry, chokeberry, mountain myrtle, bluebell, peavine, and western coneflower. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 40° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is very dark grayish-brown, dark grayish-brown, and grayish-brown loam and cobbly loam about 33 inches thick. The subsoil is yellowish-brown cobbly loam about 24 inches thick. The substratum is light olive-brown very gravelly sandy loam that extends to a depth of 69 inches. The soil is medium acid in the upper 26 inches and slightly acid below.

These soils are moderately permeable. The available water capacity is about 6 inches. The water-supplying capacity is 15 to 17 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as summer range for livestock and wildlife. They also serve as a catchment area for water and provide sites for recreation.

Representative profile of Hailman loam, 15 to 30 percent slopes, about 8.4 miles north of Midway Post Office on Pine Creek Road or 0.85 mile northwest of small pond east of road. SW¼ sec. 33, T. 2 S., R. 4 E. in a grazable woodland area. Laboratory data available.

O1—1 inch to 0, leaf litter.

A11—0 to 5 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; loose, very friable, nonsticky and nonplastic; many fine roots; 10 percent gravel; medium acid; clear, wavy boundary.

A12—5 to 15 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure parting to weak, medium, granular; slightly hard, very friable, nonsticky and slightly plastic; common fine and medium and few large roots; common fine pores; 10 percent gravel; medium acid; clear, wavy boundary.

A13—15 to 26 inches, dark grayish-brown (10YR 4/2) cobbly loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure parting to weak, fine, angular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium and few large roots; common fine pores; thin, continuous gray coatings in some pockets on ped faces; 30 percent gravel and cobbles; medium acid; clear, irregular boundary.

A3—26 to 33 inches, grayish-brown (10YR 5/2) cobbly loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard, brittle, friable, nonsticky and slightly plastic; common fine pores; thin, continuous gray coatings on ped faces; 40 percent gravel and cobbles; slightly acid; abrupt, wavy boundary.

B21—33 to 43 inches, yellowish-brown (10YR 5/4) cobbly loam, brown (10YR 4/3) moist; weak, medium, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine and medium roots; many very fine pores; few gray coatings on some ped faces in upper part; thin clay films in channels and bridges between sand grains; 45 percent gravel and cobbles; slightly acid; clear, wavy boundary.

B22—43 to 57 inches, same as B21 horizon but has no gray coatings and is brown (10YR 5/3) moist; clear, wavy boundary.

C—57 to 69 inches, light olive-brown (2.5Y 5/4) very gravelly sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; very few fine roots; very few fine pores; 85 percent weathered parent rock.

The A1 horizon has value of 3 or 4 when dry and 2 or 3 when moist and has chroma of 2. It is 17 to 29 inches thick. The B horizon has value of 5 or 6 when dry and 4 or 5 when moist and has chroma of 3 or 4. It ranges from loam to fine sandy loam. Content of cobbles and gravel ranges from 20 to 50 percent.

Hailman loam, 6 to 15 percent slopes (HAC).—This soil is mainly on ground and lateral moraines of the higher mountains. Runoff is slow, and the hazard of erosion is slight. Included in mapping are similar soils in basinlike areas that have slopes of less than 6 percent and areas of Hailman cobbly loam.

This soil is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for summer homes and for recreation. Capability unit VIe-H nonirrigated;

High Mountain Loam (Aspen) range site; wildlife group 3141.

Hailman loam, 15 to 30 percent slopes (HAD).—This soil is mainly on ground and lateral moraines of the higher mountains. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are areas of Hailman cobbly loam.

This soil is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for summer homes and for recreation. Capability unit VIe-H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Hailman soils, 40 to 60 percent slopes (HBF).—These soils are on mountainsides that have a mantle of glacial drift over the parent rock formation. Areas are about 60 percent Hailman loam and 30 percent Hailman cobbly loam, both of which have slopes of 40 to 60 percent, and about 10 percent other soils. These soils are intermingled, and either soil can dominate in a given area. These soils have profiles similar to the one described as representative of the series, but the surface layer of Hailman cobbly loam is 20 to 50 percent cobbles. Runoff is rapid, and the hazard of erosion is high. Included in mapping are small areas of Lake Janee soils.

These soils are used mainly as summer range for livestock and wildlife. They also serve as a catchment area for water and provide sites for some recreation. Capability unit VIIe-H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Henefer Series

The Henefer series consists of well-drained soils. These soils formed on alluvial fans and mountainsides in alluvium and residuum derived from mixed sedimentary rocks. Slopes range from 1 to 50 percent. The elevation ranges from 5,500 to 7,000 feet. The vegetation is mainly native bluegrass, wheatgrass, oakbrush, snowberry, geranium, and lupine. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 43° F, and the frost-free period is generally about 50 to 70 days. In irrigated valleys the frost-free period is about 80 days.

In a representative profile the surface layer is dark grayish-brown silt loam about 12 inches thick. The subsoil extends to a depth of 60 inches. It is about 8 inches of brown cobbly heavy silt loam, 28 inches of brown cobbly and very cobbly clay, and 12 inches of brown very cobbly clay loam. The soil is neutral and slightly acid in the surface layer and medium acid to neutral in the subsoil.

Henefer soils are slowly to moderately slowly permeable. The available water capacity is about 7 inches. The water-supplying capacity is 13 to 15 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as spring and fall range for livestock and wildlife. They also serve as a catchment area for water and provide sites for recreation. Some areas are irrigated and cropped.

Representative profile of Henefer silt loam, 6 to 10 percent slopes, about 2 miles southwest of Wallsburg, 1,740 feet north and 520 feet east of southwest corner of sec. 24 T. 5 S., R. 4 E. in an area of range. Laboratory data available.

O2—1 inch to 0, decomposing organic litter.

A11—0 to 3 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate, medium, granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; neutral; clear, wavy boundary.

A12—3 to 12 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, medium and fine, subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; common fine and medium pores; slightly acid; abrupt, wavy boundary.

B1—12 to 20 inches, brown (7.5YR 5/4) cobbly heavy silt loam, dark brown (7.5YR 3/3) moist; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; very hard, firm, sticky and very plastic; common fine and few medium roots; few fine pores; common thin clay films; slight to moderate gray coatings on most peds; 20 percent cobbles and stones; slightly acid; clear, wavy boundary.

B21t—20 to 36 inches, brown (7.5YR 5/4) cobbly clay, brown (7.5YR 4/4) moist; weak, coarse, prismatic structure parting to strong, fine and medium, angular blocky; extremely hard, very firm, sticky and very plastic; few fine roots; moderately thick, continuous clay films on peds; 25 percent cobbles and stones; medium acid; clear, irregular boundary.

B22t—36 to 48 inches, brown (7.5YR 5/4) very cobbly clay, brown (7.5YR 4/3) moist; weak, coarse, prismatic structure parting to strong, medium and fine, angular blocky; extremely hard, extremely firm, very sticky and very plastic; few fine roots; thick, continuous clay films on peds; 75 percent cobbles and stones; neutral; clear, wavy boundary.

B3—48 to 60 inches, brown (10YR 4/3) very cobbly clay loam, brown (10YR 4/5) moist; moderate, fine, angular blocky structure; very hard, firm, sticky and plastic; 80 percent cobbles and stones; neutral.

The A1 horizon has value of 3 to 5 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 6 to 18 inches thick. The B2t horizon has hue of 2.5YR to 7.5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 to 6. It ranges from clay to heavy clay loam and is 20 to 40 percent cobbles and stones in the upper part increasing to 75 percent in the lower part. It is 21 to 32 inches thick.

Henefer silt loam, 1 to 3 percent slopes (HeA).—This soil is mainly on alluvial fans where runoff is slow and the hazard of erosion is slight. Included in mapping are small areas of Deer Creek and Manila soils. Most of the acreage is in irrigated alfalfa hay and barley. Capability unit IIIc–3 irrigated; wildlife group 2141–I.

Henefer silt loam, 6 to 10 percent slopes (HeC).—This soil is mainly on alluvial fans. It has the profile described as representative of the series. Runoff is medium. The erosion hazard is high in irrigated areas. Included in mapping are small areas of Deer Creek and Manila soils. Most of the acreage is in irrigated alfalfa hay, pasture, and small grain. Capability units IIIe–3 irrigated, VIe–M nonirrigated; Mountain Loam range site; wildlife groups 2141 and 2141–I.

Henefer silt loam, 10 to 25 percent slopes (HeD).—This soil is mainly on alluvial fans at the foot of mountains. Runoff is medium. The erosion hazard is high in irrigated areas.

Included with this soil in mapping are small areas of Henefer cobbly silt loam. Also included are areas where gullies have formed and small areas where the surface layer has been removed.

Some of the less steep areas of this soil are in irrigated alfalfa hay and pasture. Areas not irrigated provide spring and fall range for livestock. They also serve as catchment areas for water and sites for some types of recreation. Capability units IVe–3 irrigated, VIe–M nonirrigated; Mountain Loam range site; wildlife groups 2141 and 2141–I.

Henefer-Bradshaw association, very steep (HFF).—This mapping unit is on the lower mountainsides. It is about 30 percent Henefer silt loam and 20 percent Henefer cobbly silt loam, both of which have slopes of 25 to 50 percent; 40 percent Bradshaw very cobbly very fine sandy loam, 40 to 60 percent slopes; and about 10 percent Rock outcrop. Henefer soils occur on all exposures. The Bradshaw soil is mainly on the steeper southerly exposures. Henefer soils have a profile similar to the one described as representative of the series, but the surface layer of Henefer cobbly loam is 40 percent cobbles. Runoff is rapid, and the erosion hazard is high.

Included with this unit in mapping are small scattered areas of Rock outcrop.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Henefer soils in capability unit VIIe–M nonirrigated, Mountain Loam range site, wildlife group 3141; Bradshaw soil in capability unit VIIs–M nonirrigated, Mountain Stony Loam range site, wildlife group 3242.

Henefer-Gappmayer association, very steep (HGF).—This mapping unit is on mountainsides that have numerous spur ridges. It is about 35 percent Henefer silt loam and 20 percent Henefer cobbly silt loam, both of which have slopes of 25 to 50 percent; 35 percent Gappmayer gravelly fine sandy loam, 40 to 65 percent slopes; and about 10 percent Rock outcrop. Henefer soils occur on all exposures. The Gappmayer soil is mainly on the brushy, steep, northerly exposures. Henefer soils have a profile similar to the one described as representative of the series, but the surface layer of Henefer cobbly loam is 35 percent cobbles. Runoff is rapid, and the erosion hazard is high.

Included with this unit in mapping are small scattered areas of Rock outcrop.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for some types of recreation. Henefer soils in capability unit VIIe–M nonirrigated, Mountain Loam range site, wildlife group 3141; Gappmayer soil in capability unit VIIe–M nonirrigated, Mountain Gravelly Loam (Oakbrush) range site, wildlife group 3242.

Henefer-Wallsburg association, very steep (HHF).—This mapping unit is on the lower mountainsides. It is about 35 percent Henefer silt loam and 20 percent Henefer cobbly silt loam, both of which have slopes of 25 to 50 percent; 35 percent Wallsburg very cobbly sandy clay loam, 20 to 60 percent slopes; and about 10 percent Rock outcrop. Henefer soils occur on all exposures. The Wallsburg soil is mainly on southerly exposures and ridges. Henefer soils have a profile similar to the one described as representative of the series, but the surface layer of Henefer cobbly silt loam is 35 percent cobbles. Runoff is rapid, and the erosion hazard is high.

Included with this unit in mapping are scattered areas of Rock outcrop.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for some types of recreation. Henefer soils in capability unit VIIe–M nonirrigated, Mountain Loam range site, wildlife group 3141; Wallsburg soil in capability unit VIIs–M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343.

Henefer soils, 6 to 10 percent slopes (HJC).—This mapping unit is on alluvial fans. It is about 60 percent Henefer silt loam and 30 percent Henefer cobbly silt loam, both of which have slopes of 6 to 10 percent, and about 10 percent other soils. The Henefer soils are intermingled; either can dominate in a given area. They have a profile similar to the one described as representative of the series, but the surface layer of Henefer cobbly silt loam is 35 percent cobbles. Runoff is slow. The erosion hazard is high if the soils are irrigated.

Included with this unit in mapping are small areas of Deer Creek and Manila soils.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It serves as a catchment area for water and also provides sites for recreation and summer homes. Capability unit VIe–M nonirrigated; Mountain Loam range site; wildlife group 2141.

Henefer soils, 10 to 25 percent slopes (HJD).—This mapping unit is on alluvial fans and the toe slopes of mountains. It is about 60 percent Henefer silt loam and 30 percent Henefer cobbly silt loam, both of which have slopes of 10 to 25 percent, and about 10 percent other soils. The Henefer soils are intermingled; either can dominate in a given area. They have a profile similar to the one described as representative of the series, but the surface layer of Henefer cobbly silt loam is 35 percent cobbles. Runoff is medium, and the erosion hazard is moderate.

Included with this unit in mapping are small basins of less steep soils, areas of Deer Creek and Manila soils, and in places wet spots.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It serves as a catchment area for water and provides sites for recreation and summer homes. Capability unit VIe–M nonirrigated; Mountain Loam range site; wildlife group 2141.

Henefer soils, 25 to 50 percent slopes (HJE).—This mapping unit is on the lower mountainsides. It is about 60 percent Henefer silt loam and 30 percent Henefer cobbly silt loam, both of which have slopes of 25 to 50 percent, and about 10 percent other soils and Rock outcrop. The Henefer soils are intermingled; either can dominate in a given area. They have a profile similar to the one described as representative of the series, but the surface layer of Henefer cobbly silt loam is 35 percent cobbles. Runoff is rapid, and the erosion hazard is high.

Included with this unit in mapping are scattered

areas of Rock outcrop and whitish limy soils on ridges having southerly exposures.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for some kinds of recreation. Capability unit VIIe–M nonirrigated; Mountain Loam range site; wildlife group 3141.

Holmes Series

The Holmes series consists of well-drained very gravelly soils. These soils formed on stream terraces and alluvial fans in gravelly alluvium derived from a mixture of rocks. Slopes range from 1 to 3 percent. The elevation ranges from 5,600 to 6,000 feet. The vegetation is mainly big sagebrush, native bluegrasses, and irrigated alfalfa and small grain. The average annual precipitation is 16 to 18 inches, the mean annual air temperature is about 45° F, and frost-free period is about 70 to 90 days.

In a representative profile the surface layer is brown gravelly loam about 11 inches thick. The subsoil is 17 inches thick. The upper 10 inches is brown very gravelly loam, and the lower part is yellowish-brown very gravelly heavy coarse sandy loam. The substratum is yellowish-brown very gravelly loamy coarse sand that extends to a depth of 60 inches. The soil is neutral to slightly acid throughout.

Holmes soils are rapidly permeable. The available water capacity is 3 to 4 inches. The water-supplying capacity is 6 to 8 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used for irrigated crops and wildlife habitat.

Representative profile of Holmes gravelly loam, about 2 miles south of Heber, 400 feet north of southwest corner of Heber Airport, 1,070 feet north and 18 feet east of southwest corner of sec. 7, T. 4 S., R. 5 E. in a cultivated area. Laboratory data available.

Ap—0 to 2 inches, brown (10YR 4/3) gravelly loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, friable, nonsticky and slightly plastic; many fine and few medium roots; 30 percent gravel and cobbles; abrupt, smooth boundary.

A12—2 to 11 inches, brown (10YR 4/3) gravelly loam, very dark brown (10YR 2/2) moist; weak, fine, subangular blocky structure parting to moderate, medium, granular; soft, friable, slightly sticky and slightly plastic; many fine and few medium roots; few fine pores; 30 percent gravel and cobbles; neutral; clear, wavy boundary.

B2t—11 to 21 inches, brown (10YR 4/3) very gravelly loam, dark brown (10YR 3/3) moist; weak fine, medium, and coarse, subangular blocky structure; slightly hard, firm, sticky and plastic; common fine and medium roots; few very fine pores; thin, patchy organic stains and thin, continuous clay films on peds and in pores; 50 percent gravel and cobbles; neutral; clear, wavy boundary.

B3—21 to 28 inches, yellowish-brown (10YR 5/4) very gravelly heavy coarse sandy loam, dark yellowish brown (10YR 4/4) moist; weak, medium, subangular blocky structure; loose, very friable, slightly sticky and nonplastic; common fine and few medium roots; few, thin clay films on peds; 65 percent gravel and cobbles; neutral; clear, wavy boundary.

C—28 to 60 inches, yellowish-brown (10YR 5/4) very gravelly loamy coarse sand, dark yellowish brown (10YR 4/4) moist; single grained; loose, nonsticky and nonplastic; common fine and few medium roots; 80 percent gravel, cobbles, and stones; slightly acid.

The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 6 to 15 inches thick. The B2t horizon has value of 4 or 5 when dry and 2 or 3 when moist and has chroma of 2 to 4. It ranges from loam to sandy loam that is 40 to 65 percent gravel.

Holmes cobbly sandy loam (Hk).—This soil is mainly on stream terraces and alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is sandy loam that is 20 to 50 percent cobbles and the subsoil is sandy loam that is 60 percent cobbles. Slopes are 1 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of soils where the surface layer is cobbly loam.

Most of the acreage is in irrigated pasture and hay. Capability unit IVs–34 irrigated; wildlife group 3242–I.

Holmes cobbly sandy loam, channeled (Hm).—This soil is mainly on stream terraces dissected by old meandering stream channels. It has a profile similar to the one described as representative of the series, but the surface layer is cobbly sandy loam that is 35 percent cobbles and gravel and the subsoil is very cobbly sandy loam that is 60 percent cobbles and gravel. Slopes are 1 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Included in mapping are areas where the surface layer is gravelly sandy loam.

Most of the acreage is in pasture. Capability unit IVs–34 irrigated; wildlife group 3242–I.

Holmes very cobbly sandy loam (Ho).—This soil is mainly on stream terraces and alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is very cobbly sandy loam and the subsoil is 60 percent cobbles and gravel. Slopes are 1 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of soils that have less than 50 percent cobbles in the surface layer.

This soil is used mainly as range for livestock and wildlife. It also provides some sites for recreation. Capability unit VIIs–U nonirrigated; Upland Stony Loam range site; wildlife group 3242.

Holmes gravelly loam (Hr).—This soil is mainly on stream terraces and alluvial fans. It has the profile described as representative of the series. Slopes are 1 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of Center Creek and Rasband soils, and the Steed cold variant and some areas of Holmes cobbly sandy loam.

Most of the acreage is used for irrigated alfalfa hay and pasture or wildlife habitat. Capability unit IVs–34 irrigated; wildlife group 3242–I.

Horrocks Series

The Horrocks series consists of well-drained, very cobbly soils. These soils formed on mountainsides in glacial drift derived mainly from andesite rocks. Slopes range from 6 to 60 percent. The elevation ranges from 5,500 to 7,500 feet. The vegetation is mainly bluebunch wheatgrass, slender wheatgrass, native bluegrasses, balsamroot, big sagebrush, and

oakbrush. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 44° F, and the frost-free period is about 50 to 70 days.

In a representative profile the surface layer is very dark grayish-brown very cobbly sandy clay loam about 5 inches thick. The subsoil is dark grayish-brown and brown very cobbly sandy clay loam about 22 inches thick. The substratum is pale-brown very cobbly sandy loam about 14 inches thick. Andesite bedrock is at a depth of 41 inches. The soil is neutral to slightly acid throughout.

Horrocks soils are moderately permeable. The available water capacity is 4 to 5 inches. The water-supplying capacity is 9 to 12 inches. Roots can penetrate to a depth of 40 inches or more.

These soils are used as spring and fall range for livestock and wildlife. They also serve as catchment areas for water and some provide sites for recreation.

Representative profile of Horrocks very cobbly sandy clay loam in an area of Horrocks-Broadhead association, steep, about 15 miles southwest of Heber, 2,575 feet south and 940 feet east of the corner of sec. 32, T. 4 S., R. 4 E., in an area of range. Laboratory data available.

A1—0 to 5 inches, very dark grayish-brown (10YR 3/2) very cobbly sandy clay loam, very dark brown (10YR 2/2) moist; weak, medium, granular structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; 50 percent cobbles and gravel; neutral; clear, wavy boundary.

B21t—5 to 14 inches, dark grayish-brown (10YR 4/2) very cobbly sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; slightly hard, friable, sticky and plastic; common fine, medium, and large roots; few fine pores; few, thin clay films on peds and in pores; 60 percent cobbles and stones; neutral; clear, irregular boundary.

B22t—14 to 27 inches, brown (10YR 4/3) very cobbly sandy clay loam, dark yellowish brown (10YR 3/4) moist; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; hard, firm, sticky and plastic; common fine and medium roots; few fine pores; moderately thick, continuous clay films on peds and in pores; 65 percent cobbles and stones; slightly acid; clear, irregular boundary.

C—27 to 41 inches, pale-brown (10YR 6/3) very cobbly sandy loam, dark grayish brown (10YR 4/2) moist; massive; loose, very friable, slightly sticky and slightly plastic; common fine and medium roots; 65 percent stones and cobbles; slightly acid; clear, irregular boundary.

R—41 inches, bedrock.

The A1 horizon has value of 3 or 4 when dry and 1 to 3 when moist and has chroma of 2. It is 5 to 12 inches thick. The B2t horizon has hue of 10YR to 5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 or 4. It ranges from sandy clay loam to clay loam and is 55 percent cobbles and stones. It is 12 to 22 inches thick.

Horrocks-Broadhead association, moderately steep (HWC).—This mapping unit is on sloping or rolling terminal moraines of the mountains. It is about 50 percent Horrocks very cobbly sandy clay loam and 35 percent Broadhead loam, both of which have slopes of 6 to 15 percent, and about 15 percent other soils and Rock outcrop. The Horrocks soil is mainly on the southerly exposures, and the Broadhead soil is mostly on the northerly exposures. The Broadhead soil has a profile similar to the one described as representative of the Broadhead series, but its surface layer is less than 20 percent cobbles. Runoff is slow, and the hazard of erosion is slight.

Included with this unit in mapping are small areas of Broadhead soils that have 20 to 50 percent cobbles in the surface layer, a few areas of Rock outcrop, and Broadhead soils in small basinlike areas where slopes are less than 6 percent.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation and for summer homes. Wildlife group 2141; Horrocks soil in capability unit VIIs–M nonirrigated, Mountain Stony Loam range site; Broadhead soil in capability unit VIe–M nonirrigated, Mountain Loam range site.

Horrocks-Broadhead association, steep (HWE).—This mapping unit is on hilly to steep terminal moraines of the mountains. It is about 50 percent Horrocks very cobbly sandy clay loam, 15 to 40 percent slopes; 35 percent Broadhead loam, 25 to 40 percent slopes; and about 15 percent other soils and Rock outcrop. The Horrocks soil is mainly on southerly exposures, and it has the profile described as representative of the series. Broadhead loam has a profile similar to the one described as representative of the Broadhead series, but its surface layer is less than 20 percent cobbles. Runoff is rapid, and the hazard of erosion is high.

Included with this unit in mapping are small areas of Broadhead cobbly loam and scattered areas of Rock outcrop.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Wildlife group 2141; Horrocks soil in capability unit VIIs–M nonirrigated, Mountain Stony Loam range site; Broadhead soil in capability unit VIe–M nonirrigated, Mountain Loam range site.

Horrocks-Broadhead association, very steep (HWF).—This mapping unit is on terminal moraines and mountainsides mantled with glacial drift. It is about 50 percent Horrocks very cobbly sandy clay loam and 35 percent Broadhead loam, both of which have slopes of 40 to 60 percent, and about 15 percent other soils and Rock outcrop. The Horrocks soil is on the southerly exposures, and the Broadhead soil is mainly on the northerly and easterly exposures. The Broadhead soil has a profile similar to the one described as representative of the Broadhead series, but its surface layer is less than 20 percent cobbles. Runoff is rapid, and the hazard of erosion is high.

Included with this unit in mapping are areas of Broadhead cobbly loam and a few areas of Rock outcrop.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Wildlife group 3141; Horrocks soil in capability unit VIIs–M nonirrigated and Mountain Stony Loam range site; Broadhead soil in capability unit VIIe–M nonirrigated and Mountain Loam range site.

Kovich Series

The Kovich series consists of poorly drained soils.

These soils formed on flood plains and stream terraces in alluvium derived from a mixture of rocks. Slopes range from 0 to 3 percent. The elevation ranges from 5,400 to 6,000 feet. The vegetation is mainly sedges, wiregrass, bluegrasses, timothy, redtop, and clover. The average annual precipitation is 16 to 20 inches, the mean annual air temperature is about 45° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is very dark grayish-brown and dark grayish-brown loam about 29 inches thick. The substratum extends to a depth of 60 inches. The upper 12 inches is very dark grayish-brown very cobbly light sandy clay loam. The lower part is grayish-brown very gravelly sand. The soil is slightly acid in the surface layer and neutral in the substratum.

Kovich soils are moderately permeable. The available water capacity is 7 to 8 inches. Roots can penetrate to a depth of 12 to 36 inches, depending on the depth to the water table.

These soils are used for pasture, meadow hay, and wildlife habitat.

Representative profile of Kovich loam, 1 mile north and seven-eighths of a mile west of Heber sewage plant, 2,620 feet south and 1,870 feet west of northeast corner of sec. 25, T. 3 S., R. 4 E., in a meadow area. Laboratory data available.

A11—0 to 1 inch, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak, coarse, granular structure; hard, friable, slightly sticky and slightly plastic; many fine roots; slightly acid; abrupt, wavy boundary.

A12—1 to 11 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure parting to moderate, coarse, granular; hard, friable, slightly sticky and slightly plastic; common fine roots; common medium pores; slightly acid; clear, smooth boundary.

A13—11 to 24 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; few, fine, faint mottles; weak, very coarse, subangular blocky structure parting to weak, fine and medium, subangular blocky; hard, friable, sticky and plastic; common fine roots; common medium and large pores; slightly acid; clear, smooth boundary.

A14—24 to 29 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; common, fine and medium, prominent, yellowish-red (5YR 5/7) mottles; weak, very coarse, subangular blocky structure parting to weak, fine and medium, subangular blocky; very hard, friable, sticky and plastic; few fine roots; common, medium and fine pores, slightly acid; clear, smooth boundary.

IIC1—29 to 41 inches, dark brown (10YR 4/3) very cobbly light sandy clay loam, dark brown (10YR 3/3) moist; common, fine and medium, prominent, yellowish-red (5YR 5/7) mottles; massive; hard, very friable, slightly sticky and slightly plastic; few fine roots; 75 percent gravel and cobbles; neutral; clear, smooth boundary.

IIC2—41 to 60 inches, grayish-brown (10YR 5/2) very gravelly sand, very dark grayish brown (10YR 3/2) moist; single grained; loose; few fine roots; 70 percent gravel and cobbles; neutral.

The upper part of the A1 horizon has value of 3 or 4 when dry and 2 to 3 when moist and has chroma of 1 or 2. The lower part of the A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist and has chroma of 2. There are mottles within 20 inches of the surface. The A1 horizon ranges from loam to clay loam and is 24 to 40 inches thick. The C horizon has value of 3 to 5 when dry and 3 or 4 when moist and has chroma of 2 or 3. It ranges from loam to sandy clay loam that is 50 to 80 percent gravel and cobbles.

Kovich loam (Kc).—This soil is mainly on low stream terraces. It has the profile described as representative of the series. Slopes are 1 to 3 percent. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping are areas of soils that have only 20 to 50 percent cobbles in the substratum, areas of soils that have lime in the profile, small areas of soils that have slopes of 3 to 6 percent, and small areas of soils that have a surface layer of peat.

This soil is used mainly for meadow hay or pasture and for wildlife habitat. It also provides some sites for recreation. Capability unit IIIw–3 irrigated; wildlife group 2222–I.

Kovich loam, channeled (Kd).—This soil is mainly on undulating flood plains. Areas are rough and uneven because they are dissected by abandoned stream channels. Slopes are 1 to 3 percent. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping are areas of soils that have a water table between depths of 20 and 40 inches and small areas of soils that have a gravelly or cobbly surface layer.

This soil is used mainly for pasture and wildlife habitat. Capability unit IIIw–3 irrigated; wildlife group 2222–I.

Kovich loam, moderately deep water table (Kh).—This soil is mainly on nearly level flood plains and stream terraces. The water table fluctuates between depths of 20 and 36 inches. Slopes are 0 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of soils that have a surface layer of clay loam.

The soil is used mainly for meadow hay, pasture, and some small grain. Capability unit IIIw–3 irrigated; wildlife group 2121–I.

Kovich Deep Water Table Variant

The Kovich deep water table variant consists of somewhat poorly drained soils. These soils formed on stream terraces and flood plains in alluvium derived from a mixture of rocks. Slopes range from 1 to 3 percent. The elevation ranges from 5,500 to 6,200 feet. The vegetation is mainly big sagebrush, giant wildrye, western wheatgrass, and irrigated crops. The average annual precipitation is 16 to 20 inches, the mean annual air temperature is about 45° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is very dark grayish-brown loam about 16 inches thick. The substratum is very dark grayish-brown silt loam to a depth of 27 inches, dark grayish-brown loam to a depth of 39 inches, and grayish-brown loam to a depth of 60 inches. The soil is neutral to mildly alkaline throughout.

These soils are moderately permeable. The available water capacity is 8 to 9 inches. Roots can penetrate to a depth of 30 to 40 inches.

These soils are used for alfalfa, small grain, and pasture.

Representative profile of Kovich loam, deep water table variant, from Wallsburg ball park, south 700 feet along farm lane, and west 1,700 feet; 1,550 feet east and 690 feet north of the southwest corner of sec.

18, T. 5 S., R. 5 E., in an irrigated field. Laboratory data available.

A1p—0 to 5 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak, very thick and medium, platy structure; very hard, firm, slightly sticky and slightly plastic; common fine roots; neutral; abrupt, wavy boundary.

A12—5 to 16 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; very hard, firm, slightly sticky and slightly plastic; many fine roots; neutral; clear, smooth boundary.

C1—16 to 27 inches, very dark grayish-brown (10YR 3/2) silt loam, very dark brown (10 YR 2/2) moist; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; very hard, firm, slightly sticky and plastic; common fine roots; common fine and medium pores; slightly calcareous; neutral; diffuse, smooth boundary.

C2—27 to 39 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure; very hard, friable, slightly sticky and plastic; few fine roots; common fine pores; mildly alkaline; clear, smooth boundary.

C3—39 to 60 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; few, fine, faint mottles; massive; slightly hard, friable, slightly sticky and plastic; few fine roots; mildly alkaline.

The A1 horizon has value of 3 or 4 when dry and 1 or 2 when moist and has chroma of 1 or 2. It is 8 to 18 inches thick. It ranges from neutral to mildly alkaline. The C horizon has hue of 2.5 Y or 10YR, value of 3 or 4 when dry and 2 or 3 when moist, and chroma of 1 or 2. It is noncalcareous to slightly calcareous and ranges from neutral to moderately alkaline. Faint and distinct mottles occur at a depth of 30 to 40 inches. It is loam to a depth of 39 inches or more but ranges to very gravelly loamy sand at varying depths between 39 and 72 inches.

Kovich loam, deep water table variant (Km).—This soil is mainly on stream terraces and flood plains. Slopes are 2 to 5 percent. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping are small areas of a similar soil that has a water table at a depth of 48 to 60 inches and some areas of well-drained soils.

This soil is used mainly for irrigated alfalfa, small grain, and pasture. Capability unit IIIw–3 irrigated; wildlife group 2121–I.

Kovich Gravelly Subsoil Variant

The Kovich gravelly subsoil variant consists of poorly drained loamy soils. These soils formed on stream terraces in alluvium derived from a mixture of rocks. Slopes range from 1 to 3 percent. The elevation ranges from 5,400 to 6,000 feet. The vegetation is mainly meadow grasses, sedges, and rushes. The average annual precipitation is 16 to 20 inches, the mean annual air temperature is about 44° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is very dark grayish-brown loam about 14 inches thick. The next layer is dark grayish-brown very fine sandy loam about 7 inches thick. The substratum is brown very cobbly loamy coarse sand that extends to a depth of 60 inches. The soil is mildly alkaline and moderately alkaline in the surface layer and neutral below.

These soils are moderately permeable. The available water capacity is 4 to 5 inches in drained areas. Roots can penetrate to a depth of 18 to 30 inches.

These soils are used for irrigated meadow, pasture, and hay.

Representative profile of Kovich loam, gravelly subsoil variant, about 1/2 mile north and 1/8 mile east of the Provo River bridge east of Midway, in the SE1/4 sec. 36, T. 3 S., R. 4 E., in a meadow area.

A11—0 to 2 inches, very dark grayish-brown (10YR 3/2) loam, very dark grayish brown (10YR 4/2) moist; weak, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; moderately alkaline; abrupt, smooth boundary.

A12—2 to 6 inches, very dark grayish brown (10YR 3/2) loam; very dark brown (10YR 1/2) moist; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; hard, firm, slightly sticky and slightly plastic; many fine roots; very few fine pores; mildly alkaline; abrupt, smooth boundary.

A13—6 to 14 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; hard, firm, slightly sticky and slightly plastic; common fine roots; mildly alkaline; abrupt, smooth boundary.

AC—14 to 21 inches, dark grayish-brown (10YR 4/2) very fine sandy loam, very dark brown (10YR 2/2) moist; few, medium, distinct, dark reddish-brown (5YR 3/4) mottles; weak, fine, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and medium roots; few medium pores; neutral; abrupt, smooth boundary.

IIC—21 to 60 inches, brown (10YR 5/3) very cobbly loamy coarse sand, dark brown (10YR 3/3) moist; many coarse, prominent, olive-brown (2.5Y 3/4) mottles; single grained; loose; few fine and medium roots; neutral.

The A1 horizon has value of 3 or 4 when dry and 1 to 3 when moist and has chroma of 2. It is loam in most profiles but is light clay loam in the lower part in some profiles. It is 11 to 20 inches thick. The AC horizon has value of 4 or 5 when dry and 2 or 3 when moist and has chroma of 2 to 4. It ranges from very fine sandy loam to sandy clay loam that is mainly free of gravel, although content of gravel ranges to 35 percent in some places. It is 7 to 10 inches thick. The IIC horizon ranges from sand to loamy sand or light sandy loam that is very gravelly or very cobbly. It is 50 to 80 percent gravel and cobbles. Depth to this horizon ranges from 18 to 30 inches.

Kovich loam, gravelly subsoil variant (Kp).—This soil is mainly on stream terraces. It has the profile described as representative of the variant. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping are small areas of Kovich loam and Kovich loam, deep water table variant, and small areas of soils that have a peaty surface layer.

This soil is used mainly as wet meadow pasture and meadow hayland. Capability unit IVw–34 irrigated; wildlife group 2222–I.

Kovich loam, gravelly subsoil variant, channeled (Kr).—This soil is mainly on stream terraces and flood plains in areas where many old meandering abandoned stream channels dissected the surfaces. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping are small areas of Kovich loam and Kovich loam, deep water table variant, and small ponded areas.

This soil is used mainly for meadow pasture. Capability unit IVw–34 irrigated; wildlife group 2222–I.

Kovich loam, gravelly subsoil variant, moderately deep water table (Ks).—This soil is mainly on stream terraces. It has a profile similar to the one described as representative of the variant, but the mottles begin at greater depths. The water table is below a depth of 36 inches during the growing season. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for irrigated meadow hay and pasture. Capability unit IVw–34 irrigated; wildlife group 2222–I.

Lake Janee Series

The Lake Janee series consists of well-drained soils. These soils formed on northerly and easterly exposure of mountain moraines in glacial drift derived from quartz-diorite porphyry. Slopes range from 15 to 40 percent. The elevation ranges from 8,000 to 10,000 feet. The vegetation is mainly alpine fir, Engelmann spruce, aspen, gooseberry, red elderberry, elkweed, and dryland sedge. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 40° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is dark grayish-brown cobbly sandy loam about 2 inches thick. The subsoil is 64 inches thick. The upper 22 inches is brown cobbly fine sandy loam and cobbly sandy loam, and the lower part is light yellowish-brown cobbly coarse sandy loam and cobbly sandy loam. The substratum to a depth of 80 inches is about 70 percent weathered granite and 30 percent light yellowish-brown cobbly coarse sandy loam. The soil is slightly acid in the surface layer and medium acid below.

Lake Janee soils are moderately permeable. The available water capacity is about 5 inches. The water-supplying capacity is 14 to 16 inches. Roots can penetrate to a depth of 48 inches or more.

These soils are used for woodland and wildlife habitat. They also serve as catchment areas for water and provide sites for recreation and summer homes.

Representative profile of Lake Janee cobbly loam in an area of Lake Janee soils, 15 to 40 percent slopes, about 15 miles northwest of Heber, 1,200 feet south and 4,360 feet west of the northeast corner of sec. 31, T. 2 S., R. 4 E., in woodland. Laboratory data available.

A1—0 to 2 inches, dark grayish-brown (10YR 4/2) cobbly sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; slightly hard, very friable, slightly plastic; many fine roots; 25 percent cobbles and gravel; slightly acid; abrupt, wavy boundary.

B21—2 to 14 inches, brown (10YR 5/3) cobbly fine sandy loam, brown (10YR 4/3) moist; weak, medium, subangular blocky structure; friable, slightly sticky; many fine and medium roots; 20 percent cobbles and gravel; medium acid; gradual, wavy boundary.

B22—14 to 24 inches, brown (10YR 5/3) cobbly sandy loam, brown (10YR 4/3) moist; weak, medium, subangular blocky structure; very friable, slightly sticky; many fine and medium roots; common fine and medium pores; thin, patchy clay films in pores; 30 percent cobbles and gravel; medium acid; gradual, wavy boundary.

B23—24 to 36 inches, light yellowish-brown (10YR 6/4) cobbly coarse sandy loam, yellowish brown (10YR 5/5) moist; weak, medium, subangular blocky structure; friable, slightly sticky and slightly plastic; common fine and medium roots; many medium pores; thin clay films in pores and on peds; 30 percent cobbles and gravel; medium acid; gradual, wavy boundary.

B24—36 to 48 inches, light yellowish-brown (10YR 6/4) cobbly sandy loam, yellowish brown (10YR 5/5) moist, other characteristics the same as B23 horizon; clear, wavy boundary.

B25—48 to 66 inches, light yellowish-brown (10YR 6/4) cobbly sandy loam, yellowish brown (10YR 5/4) moist; weak, fine, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; common fine pores; few thin clay films in pores and faces of peds; 35 percent cobbles, gravel, and stones; medium acid; clear, irregular boundary.

C—66 to 80 inches, about 70 percent weathered granite rock and 30 percent light yellowish-brown (10YR 6/4) cobbly coarse sandy loam, yellowish brown (10YR 5/4) moist; very weak, medium and fine, subangular blocky structure; friable, slightly sticky and slightly plastic; few fine roots; few fine pores; 35 percent gravel and cobble-sized pieces of parent rock; medium acid.

The A1 horizon is 0 to 2 inches thick. The B horizon has value of 5 or 6 when dry and 4 to 5 when moist and has chroma of 3 to 5. It is fine sandy loam or sandy loam that is less than 18 percent clay, more than 15 percent fine or coarser sand, and 20 to 35 percent cobbles and stones.

Lake Janee soils, 15 to 40 percent slopes (LAE).—This mapping unit is on ground and lateral moraines of the high mountains. It is about 40 percent Lake Janee cobbly sandy loam and 40 percent Lake Janee sandy loam, both of which have slopes of 15 to 40 percent, and about 20 percent other soils and Rock outcrop. Generally these soils are intermingled, and either soil can dominate in a given area. Lake Janee cobbly sandy loam has the profile described as representative of the series. Lake Janee sandy loam has a similar profile, but its surface layer is less than 20 percent cobbles. Runoff is medium, and the hazard of erosion is high.

Included with this unit in mapping are areas of soil that have a subsoil of cobbly sandy clay loam and areas of Rock outcrop.

This mapping unit is used mainly for woodland and wildlife. It also serves as a catchment area for water and provides sites for recreation and summer homes. Capability unit VIe–HC nonirrigated; woodland; wildlife group 3141.

Little Pole Series

The Little Pole series consists of well-drained, shallow soils. These soils formed on southerly exposures of mountainsides in residuum derived from andesite rocks. Slopes range from 6 to 60 percent. The elevation ranges from 6,300 to 7,200 feet. The vegetation is mainly snowberry, oakbrush, birchleaf mountainmahogany, bluebunch wheatgrass, native bluegrasses, and oniongrass. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 43° F, and the frost-free period is about 50 to 70 days.

In a representative profile the surface layer is very dark grayish-brown and dark grayish-brown very cobbly sandy clay loam and cobbly sandy clay loam about 10 inches thick. The subsoil is grayish-brown cobbly sandy clay loam about 6 inches thick. Weathered andesite rock is at a depth of about 16 inches. The soil is neutral throughout.

Little Pole soils are moderately permeable. The available water capacity is 1 to 2 inches to a depth of 20 inches. The water-supplying capacity is 4 to 6 inches. Roots can penetrate to a depth of 10 to 20 inches, depending on depth to bedrock.

These soils are used as spring and fall range for livestock and wildlife. They also serve as catchment areas for water and provide some sites for recreation.

Representative profile of Little Pole very cobbly sandy clay loam, 40 to 60 percent slopes, in an area of Broadhead-Little Pole association, very steep, about 2 miles north of Heber, 1,690 feet south and 1,020 feet east of northwest corner of sec. 21, T. 3 S., R. 5 E. in an area of range. Laboratory data available.

A11—0 to 5 inches, very dark grayish-brown (10YR 3/2) very cobbly sandy clay loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; 50 percent cobbles and gravel; neutral; clear, wavy boundary.

A3—5 to 10 inches, dark grayish-brown (10YR 4/2) cobbly sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; hard, friable, sticky and plastic; many fine and medium roots; few medium pores; 40 percent cobbles and gravel; neutral; clear, wavy boundary.

B2—10 to 16 inches, grayish-brown (10YR 5/2) cobbly sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; very hard, firm, sticky and plastic; few fine roots; few fine pores; thin, patchy clay films; 50 percent cobbles and gravel; neutral; abrupt, irregular boundary.

R—16 inches, weathering andesite rock.

The A1 horizon has value of 3 or 4 when dry and 2 or 3 when moist. It is 5 to 10 inches thick. The B2 horizon has value of 5 or 6 when dry and 3 or 4 when moist and has chroma of 2 or 3. It is 4 to 10 inches thick and ranges from cobbly sandy clay loam to cobbly loam that is 35 to 50 percent cobbles. It is underlain by bedrock at a depth of less than 20 inches.

Little Pole very cobbly sandy clay loam, 6 to 25 percent slopes (LPD).—This soil is mainly on the southerly mountainsides. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are concave or basinlike areas of Broadhead loam and Broadhead cobbly loam and scattered areas of Rock outcrop.

This soil is used mainly as spring and fall range for livestock and wildlife. It also serves as catchment areas for water and provides some sites for recreation. Capability unit VIIs–M nonirrigated; Mountain Shallow Loam range site; wildlife group 4343.

Little Pole very cobbly sandy clay loam, 40 to 60 percent slopes (LPF).—This soil is mainly on very steep mountainsides. Runoff is very rapid, and the hazard of erosion is high. Included in mapping are small areas of Broadhead loam and cobbly loam and scattered areas of Rock outcrop.

This soil is used mainly as spring and fall range for livestock and wildlife. It also serves as catchment areas for water and provides some sites for recreation. Capability unit VIIs–M nonirrigated; Mountain Shallow Loam range site; wildlife group 4343.

Logan Variant

The Logan variant consists of poorly drained soils. These soils formed on stream terraces and flood plains in alluvium derived from a mixture of rocks. Slopes range from 1 to 3 percent. The elevation ranges from 5,300 to 5,500 feet. The vegetation is mainly wiregrass, native bluegrasses, timothy, sedges, redtop, and clovers. The average annual precipitation is 16 to 19 inches, the mean annual air temperature is about 44° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is very dark grayish-brown and dark-gray silty clay about 10 inches thick. The substratum extends to a depth of 60 inches. In sequence from the top is 6 inches of gray silty clay, 13 inches of gray and grayish-brown loam, 6 inches of brown gravelly loam, 9 inches of grayish-brown sandy loam, and 16 inches of dark-gray very gravelly loamy sand. The soil is mildly alkaline in the upper 44 inches and moderately alkaline below.

These soils are moderately slowly permeable. The available water capacity is 6 to 7 inches. Roots can penetrate to a depth of 12 to 24 inches, depending on the depth to water table.

These soils are used for meadow hay, pasture, and wildlife habitat.

Representative profile of Logan silty clay, cold variant, about 3 miles southwest of Heber, 1,625 feet east and 850 feet south of the northwest corner of sec. 11, T. 4 S., R. 4 E., in a meadow pasture. Laboratory data available.

A11—0 to 2 inches, very dark grayish-brown (2.5Y 3/2) light silty clay, very dark brown (10YR 1/2) moist; moderate, medium, granular structure; hard, friable, slightly sticky and slightly plastic; many fine roots; moderately calcareous; mildly alkaline; abrupt, smooth boundary.

A12—2 to 10 inches, dark-gray (10YR 4/1) silty clay, black (10YR 2/1) moist; strong, medium and coarse, granular structure; very hard, firm, sticky and plastic; many fine and medium roots; strongly calcareous; mildly alkaline; diffuse, wavy boundary.

C1ca—10 to 16 inches, gray (10YR 5/1) silty clay, black (2.5Y 2/1) moist; moderate, coarse, subangular blocky structure parting to fine and medium, subangular blocky; very hard, firm, sticky and plastic; common fine and medium roots; few large and many very fine pores; very strongly calcareous; mildly alkaline; diffuse, wavy boundary.

C2ca—16 to 23 inches, gray (10YR 5/1) loam, black (2.5Y 2/1) moist; moderate, coarse, subangular blocky structure parting to medium and fine, blocky; very hard, firm, sticky and plastic; common fine and medium roots; few medium pores; strongly calcareous; mildly alkaline; clear, smooth boundary.

C3—23 to 29 inches, grayish-brown (2.5Y 5/2) loam, very dark grayish brown (2.5Y 3/2) moist; few, fine, faint mottles; weak, fine and medium, subangular blocky structure; very hard, friable, sticky and slightly plastic; few fine and medium roots; few medium pores; slightly calcareous; mildly alkaline; abrupt, smooth boundary.

C4—29 to 35 inches, brown (10YR 5/3) gravelly loam, very dark grayish brown (10YR 3/2) moist; common, medium, prominent, strong-brown (7.5YR 5/6) mottles; massive; very hard, friable, sticky and slightly plastic; few fine roots; few medium pores; 25 percent gravel and cobbles; noncalcareous; mildly alkaline; abrupt, wavy boundary.

C5—35 to 44 inches, grayish-brown (2.5Y 5/2) sandy loam, very dark grayish brown (10 YR 3/2) moist; massive; hard, very friable, nonsticky and slightly plastic; noncalcareous; mildly alkaline.

IIC6—44 to 60 inches, dark-gray (10YR 4/1) very gravelly loamy sand, black (10YR 2/1) moist; single grained; slightly hard, loose, nonsticky and nonplastic; noncalcareous; moderately alkaline (pH 7.9).

The A1 horizon has value of 3 or 4 when dry and 1 or 2 when moist and has chroma of 0 to 3. It is 10 to 12 inches thick. The Cca horizon has hue of 10YR and 2.5Y, value of 5 or 6 when dry and 2 to 4 when moist, and chroma of 0 or 1. It is 13 to 21 inches thick and ranges from silty clay to loam. The C3 and C4 horizons have hue of 2.5Y and 10YR, value of 5 or 6 when dry and 2 to 4 when moist, and chroma of 2 or 3. These horizons are mottled and range from loam to clay loam. Gravel and cobbles occur at a depth of 30 to 60 inches, with

the amount increasing to as much as 85 percent in the lower part.

Logan silty clay, cold variant (Lr).—This soil is mainly on stream terraces and flood plains. Slopes are 1 to 3 percent. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping are areas of soils that have a water table as deep as 36 inches during part of the growing season, soils that have gravel at a depth of 17 to 40 inches, small areas of soils that have a peaty surface layer, and small areas of soils that have a very uneven surface layer.

This soil is used mainly for meadow hay and pasture. Capability unit IIIw–3 irrigated; wildlife group 2222–I.

Manila Series

The Manila series consists of well-drained soils. These soils formed mainly on north and east exposures of alluvial fans in alluvium derived from mixed sedimentary rocks. Slopes range from 3 to 20 percent. The elevation ranges from 5,500 to 6,000 feet. The vegetation is mainly native bluegrasses, wheatgrasses, oakbrush, snowberry, big sagebrush, geranium, and lupine. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 43° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is dark grayish-brown and brown silt loam about 18 inches thick. The subsoil extends to a depth of 97 inches. The upper 17 inches is brown silty clay and silty clay loam, and the lower part is reddish-brown, light reddish-brown, and brown silty clay and light silty clay. The soil is neutral to a depth of 72 inches and mildly alkaline below.

Manila soils are slowly permeable. The available water capacity is about 11 inches. The water-supplying capacity is 14 to 16 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used for irrigated crops and as spring and fall range for livestock and wildlife. They also serve as catchment areas for water and provide some sites for recreation.

Representative profile of Manila silt loam, 6 to 10 percent slopes, one-half mile south and one-half mile west of Midway, 50 feet east, 240 feet north of northwest corner of Midway cemetery, 1,000 feet east and 1,200 feet south of northwest corner of sec. 3 T. 4 S., R. 4 E. in an irrigated area. Laboratory data available.

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate, coarse and medium, granular structure; hard, firm, slightly sticky and slightly plastic; many fine and few medium roots; few medium and common fine pores; neutral; gradual, smooth boundary.

A12—10 to 18 inches, brown (10YR 4/3) silt loam, very dark brown (10YR 2/3) moist; moderate, coarse, subangular blocky structure parting to strong, fine and medium, subangular blocky; hard, firm, slightly sticky and slightly plastic; few fine and very fine roots; few medium and common fine continuous pores; neutral; clear, smooth boundary.

B1—18 to 26 inches, brown (7.5YR 4/3) silty clay loam, dark brown (7.5YR 3/2) moist; moderate, coarse, subangular blocky structure parting to strong, fine and medium, subangular blocky; very hard, firm, sticky and plastic; very few fine and very fine roots; few medium and fine continuous pores; moderately thick, continuous clay films on peds; neutral; gradual, smooth boundary.

B21t—26 to 35 inches, brown (7.5YR 5/4) silty clay, reddish brown (5YR 4/4) moist; moderate, medium and coarse, angular blocky structure parting to strong, fine, angular blocky; very hard, very firm, very sticky and plastic; very few fine and very fine roots; very few medium and few fine continous pores; moderately thick, continous clay films on peds; neutral; gradual, smooth boundary.

B22t—35 to 50 inches, reddish-brown (5YR 5/4) light silty clay, reddish brown (5YR 4/4) moist; moderate, coarse and medium, angular blocky structure; very hard, very firm, very sticky and very plastic; very few fine and very fine roots; very few medium and few fine continuous pores; moderately thick, continuous clay films on peds; neutral; diffuse boundary.

B31—50 to 72 inches, light reddish-brown (5YR 6/4) silty clay, reddish brown (5YR 4/3) moist; weak, medium, subangular blocky structure; very hard, very firm, very sticky and very plastic; some lime splotches; neutral; clear, smooth boundary.

B32—72 to 97 inches, brown (7.5YR 5/4) light silty clay, brown (7.5YR 4/3) moist; weak, medium, subangular blocky structure; very hard, very firm, very sticky and very plastic; mildly alkaline.

The A1 horizon has value of 3 or 4 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 10 to 20 inches thick. The B2t horizon has hue of 7.5YR and 5YR, value of 4 or 5 when dry and 3 or 4 when moist, and chroma of 3 to 6. It ranges from silty clay to heavy silty clay loam that is more than 35 percent clay. Content of gravel and cobbles is less than 20 percent. This horizon is 20 to more than 40 inches thick. Typically, the B3 horizon extends below a depth of 60 inches and has lime splotches on some peds and pebbles.

Manila silt loam, 3 to 6 percent slopes (MaB).—This soil is mainly on alluvial fans. Runoff is slow, and the hazard of erosion is moderate in the irrigated areas. Included in mapping are Manila soils that have slopes of less than 3 percent, areas of moderately eroded soils, and small areas of Deer Creek soils.

Most of the acreage is in irrigated alfalfa, small grain, and pasture. Capability unit IIIe–3 irrigated; wildlife group 2141–I.

Manila silt loam, 6 to 10 percent slopes (MaC).—This soil is mainly on alluvial fans at the base of the mountains. It has the profile described as representative of the series. Runoff is medium, and the hazard of erosion is high in the irrigated areas. Included in mapping are areas where the surface layer is silty clay loam, areas of moderately eroded soil, small areas of soil that have lime in the profile, and wet spots or seeps.

Most of the acreage is in irrigated alfalfa, small grain, and pasture. Capability unit IIIe–3 irrigated; wildlife group 2141–I.

Manila silt loam, 10 to 20 percent slopes (MaD).—This soil is mainly on alluvial fans. Runoff is rapid, and the hazard of erosion is high in irrigated areas. Included in mapping are similar soils that are eroded and areas of soil that have a cobbly subsoil.

Most of the acreage is in irrigated alfalfa and pasture. Capability unit IVe–3 irrigated and VIe–M nonirrigated; Mountain Loam range site; wildlife group 2141 and 2141–I.

McPhie Series

The McPhie series consists of well-drained, cobbly

soils. These soils formed on easterly exposures of terminal moraines of the mountains in glacial drift derived mainly from quartz-diorite porphyry rocks. Slopes range from 40 to 60 percent. The elevation ranges from 6,300 to 7,200 feet. The vegetation is mainly oakbrush, maple, scattered Douglas-fir, mountain bromegrass, and tall native bluegrasses. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 43° F, and the frost-free period is about 50 to 70 days.

In a representative profile the surface layer is very dark grayish-brown fine sandy loam about 13 inches thick. The subsurface layer is pale-brown fine sandy loam about 15 inches thick. The subsoil is light yellowish-brown cobbly fine sandy loam about 26 inches thick. The substratum is pale-brown very cobbly loamy sand to a depth of 78 inches. The soil is slightly acid to medium acid.

McPhie soils are moderately permeable. The available water capacity is about 6 inches. The water-supplying capacity is 11 to 14 inches. Roots can penetrate to a depth of 48 inches or more.

These soils are used as range for livestock and wildlife. They also serve as catchment areas for water and provide some sites for recreation.

Representative profile of McPhie fine sandy loam, 40 to 60 percent slopes, about 4 miles north of Midway, 1,760 feet south and 3,600 feet east of the northwest corner of sec. 16, T. 3 S., R. 4 E. in an area of range. Laboratory data available.

O1—3 inches to 1 inch, oakbrush leaves.

O2—1 inch to 0, duff from decomposing oakbrush leaves and roots.

A11—0 to 3 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, very friable; many fine roots; slightly acid; clear, wavy boundary.

A12—3 to 13 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak, medium, granular structure; soft, very friable, slightly sticky; many fine and medium roots; slightly acid; abrupt, irregular boundary.

A2—13 to 28 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; about 25 percent tongues of A12 material; weak, coarse, subangular blocky structure parting to weak, fine and medium, subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine and few medium roots; common fine pores; slightly acid; clear, wavy boundary.

B&A—28 to 37 inches, light yellowish-brown (10YR 6/4) cobbly fine sandy loam, dark yellowish brown (10YR 4/4) moist; moderate, coarse, subangular blocky structure parting to medium and fine, subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine and medium roots; few fine pores; 30 percent soft weathered cobbles; moderately thick, continuous clay films on peds; pockets of the A2 part have thin, patchy gray coatings; medium acid; clear, wavy boundary.

B2t—37 to 54 inches, light yellowish-brown (10YR 6/4) cobbly fine sandy loam, dark yellowish brown (10YR 4/4) moist; moderate, coarse, subangular blocky structure parting to medium and fine, subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine and medium roots; few fine pores; 30 percent soft weathered cobbles; moderately thick, continuous clay films on peds; medium acid; gradual, wavy boundary.

B3—54 to 64 inches, light yellowish-brown (10YR 6/4) cobbly fine sandy loam, dark yellowish brown (10YR 4/4) moist; moderate, coarse, subangular blocky structure parting to weak, fine and medium, subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; 30 percent soft weathered cobbles; thin, patchy clay films on peds; slightly acid; clear, irregular boundary.

C—64 to 78 inches, pale-brown (10YR 6/3) very cobbly loamy sand, brown (10YR 5/3) moist; single grained; loose; few fine roots; 80 percent weathered cobbles; slightly acid.

The A1 horizon has value of 3 or 4 when dry and 1 or 2 when moist and has chroma of 2 or 3. It is 10 to 13 inches thick. The A2 horizon has value of 5 or 6 when dry and 4 when moist and has chroma of 3 or 4. It is 10 to 15 inches thick and ranges from sandy loam to fine sandy loam that is 0 to 35 percent cobbles. The B2t horizon has value of 5 or 6 when dry and chroma of 4 to 6. It ranges from light loam to fine sandy loam that is 20 to 35 percent cobbles.

McPhie fine sandy loam, 40 to 60 percent slopes (MCF).—This soil is mainly on easterly exposures of very steep terminal moraines. It has the profile described as representative of the series. Runoff is rapid, and the hazard of erosion is high. Included in mapping are small areas of McPhie cobbly fine sandy loam.

This soil is used mainly as range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Capability unit VIIe–M nonirrigated; Mountain Gravelly Loam (Oakbrush) range site; wildlife group 3141.

McPhie-Henefer association, very steep (MHF).—This mapping unit is on easterly exposures of mountainsides. It is about 60 percent McPhie fine sandy loam, 40 to 60 percent slopes; 30 percent Henefer silt loam, 25 to 50 percent slopes; and 10 percent cobbly soils and scattered areas of Rock outcrop. The McPhie soils are steeper than the Henefer soils. Runoff is rapid, and the hazard of erosion is high. The hazard of soil blowing is moderate. Included in mapping are small areas of McPhie cobbly fine sandy loam and Henefer cobbly silt loam.

This mapping unit is used mainly as range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Capability unit VIIe–M nonirrigated; wildlife group 3141; McPhie soil in Mountain Gravelly Loam (Oakbrush) range site, Henefer soil in Mountain Loam range site.

Mult Variant

The Mult variant consists of well-drained soils. These soils formed on the higher mountains in glacial drift derived mainly from andesite rocks. Slopes range from 5 to 40 percent. The elevation ranges from 6,500 to 8,000 feet. The vegetation is mainly aspen and a few spruce and fir trees and an understory of snowberry, meadowrue, western coneflower, sedges, and bearded wheatgrass. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 40° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is very dark gray and dark-gray loam about 16 inches thick. The subsoil is 54 inches thick. The upper 16 inches is pale-brown heavy sandy clay loam, and the lower part is pale-brown gravelly heavy sandy loam. The soil is medium acid to neutral.

These soils are moderately permeable. The available water capacity is about 8 inches. The water-

supplying capacity is 16 to 18 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as summer range for livestock and wildlife and as woodland. They also serve as catchment areas for water and provide sites for recreation.

Representative profile of Mult loam, thick solum variant, in an area of Mult soils, thick solum variant, 5 to 25 percent slopes, in the South Fork of Deer Creek, SW¼SW¼SW¼ of sec. 22, T. 4 S., R. 3 E., in a grazable woodland area. Laboratory data available.

A11—0 to 4 inches, very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; moderate, coarse, granular structure; soft, friable, slightly plastic; many fine roots; 10 percent gravel; slightly acid; clear, smooth boundary.

A12—4 to 16 inches, dark-gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate, coarse, subangular blocky structure parting to weak, fine, granular; slightly hard, friable, slightly sticky and slightly plastic; common fine and few medium and coarse roots; few fine pores; 5 percent gravel; medium acid; clear, wavy boundary.

B&A—16 to 18 inches, gray (10YR 5/1) clay loam, very dark gray (10YR 3/1) moist; weak, fine, subangular blocky structure; hard, friable, sticky and plastic; common fine roots; few thin clay films; gray coatings on faces of some peds; 10 percent gravel; medium acid; clear, wavy boundary. This horizon is intermittent.

B2t—18 to 32 inches, pale-brown (10YR 6/3) heavy sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse, prismatic structure parting to moderate, medium, blocky; very hard, very firm, sticky and plastic; very few fine roots and pores; many moderately thick clay films; 10 percent gravel; medium acid; gradual, irregular boundary.

B3—32 to 70 inches, pale-brown (10YR 6/3) gravelly heavy sandy loam, dark grayish brown (10YR 4/2) moist; moderate, fine, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; very few fine roots and pores; few thin clay films; 35 percent gravel; slightly calcareous; neutral.

The A1 horizon has value of 3 or 4 when dry and 2 or 3 when moist and has chroma of 1 or 2. It is 15 to 24 inches thick. The B2t horizon has hue of 10YR to 5YR, value of 5 or 6 when dry and 3 or 4 when moist, and chroma of 2 or 3. It is 14 to 30 inches thick and ranges from clay loam to heavy sandy clay loam that is less than 35 percent clay. The B2t horizon ranges from 0 to 25 percent gravel in the upper part to 50 to 60 percent in the lower part.

Mult clay loam, thick solum variant, 25 to 40 percent slopes (MRE).—This soil is mainly on steep glacial moraines of the higher mountains. It has a profile similar to the one described as representative of the variant, but it is 40 percent cobbles, the surface layer is clay loam, and the subsoil has a more reddish color. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are similar soils that have a finer textured cobbly subsoil.

This soil is used mainly as summer range for livestock and wildlife and as woodland. It also serves as a catchment area for water. Capability unit VIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Mult soils, thick solum variant, 5 to 25 percent slopes (MSD).—This mapping unit is on lateral moraines of mountainsides. It is about 50 percent Mult loam, thick solum variant, and about 35 percent Mult cobbly loam, thick solum variant, both of which have slopes of 5 to 25 percent, and about 15 percent other soils. Generally, these soils are intermingled, and either soil may dominate in a given area. The cobbly loam soil is scattered throughout the landscape but is generally on the ridges. Mult loam, thick solum variant, has the profile described as representative of this variant. Mult cobbly loam, thick solum variant, has a similar profile, but its surface layer is 35 percent cobbles. Runoff is slow, and the hazard of erosion is slight. Included in mapping are similar soils that have a finer textured cobbly subsoil.

This mapping unit is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Poleline Series

The Poleline series consists of well-drained, very gravelly soils. These soils formed on mountainsides in colluvium derived mainly from sandstone and quartzite rocks. Slopes range from 40 to 70 percent. The elevation ranges from 7,500 to 9,500 feet. The vegetation is mainly aspen and scattered spruce and fir and an understory of snowberry, chokecherry, mountain bromegrass, and slender wheatgrass. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 40° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is very dark grayish-brown, dark-brown, and dark grayish-brown gravelly loam and very gravelly loam about 32 inches thick. The subsoil is light-brown very gravelly sandy loam about 12 inches thick. Highly fractured sandstone is at a depth of 44 inches. The soil is slightly acid throughout.

The soils are moderately permeable. The available water capacity is about 5 inches. The water-supplying capacity is 14 to 16 inches. Roots can penetrate to a depth of 48 inches or more.

These soils are used as summer range for livestock and wildlife and as woodland. They also serve as catchment areas for water and provide sites for recreation.

Representative profile of Poleline gravelly loam, 40 to 70 percent slopes, about 10 miles southwest of Heber in the NE¼SE¼NE¼ of sec. 15, T. 4 S., R. 3 E. in a grazable woodland area. Laboratory data available.

A11—0 to 8 inches, very dark grayish-brown (10YR 3/2) gravelly loam, very dark brown (10YR 2/2) moist; moderate, medium and fine, granular structure; soft, very friable, slightly sticky; many fine roots; 45 percent gravel; slightly acid; clear, wavy boundary.

A12—8 to 20 inches, dark-brown (10YR 4/3) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak, medium and coarse, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine, common medium, and few large roots; 45 percent gravel; slightly acid; clear, wavy boundary.

A13—20 to 32 inches, dark grayish-brown (10YR 4/2) very gravelly loam, dark brown (10YR 3/3) moist; weak, medium, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and very fine roots; 50 percent gravel; slightly acid; clear, wavy boundary.

B2—32 to 44 inches, light-brown (7.5YR 6/3) very gravelly sandy loam, brown (7.5YR 4/3) moist; weak subangu-

lar blocky structure; slightly hard; few fine and common medium roots; 50 percent gravel; slightly acid; abrupt; irregular boundary.
R—44 inches, highly fractured sandstone.

The A1 horizon has value of 3 or 4 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 20 to 30 inches thick and is very gravelly below a depth of about 20 inches. The B horizon has hue of 10YR and 7.5YR, value of 6 or 7 when dry and 4 or 5 when moist, and chroma of 2 to 4. It ranges from sandy loam to very fine sandy loam that is 50 to 80 percent gravel. The soil is more than 40 inches deep over bedrock.

Poleline soils, 40 to 70 percent slopes (POF).—This mapping unit is on steep sides of the higher mountains. It is about 45 percent Poleline gravelly loam and about 45 percent Poleline cobbly loam, both of which have slopes of 40 to 70 percent, and about 10 percent other soils. Generally, these soils are intermingled, and either soil may dominate in a given area. Poleline gravelly loam has the profile described as representative of the series. Poleline cobbly loam has a similar profile, but its surface layer is cobbly instead of gravelly. Runoff is rapid, and the hazard of erosion is high. Included with this unit in mapping are small areas of similar soils where the surface layer is more than 50 percent cobbles.

This mapping unit is used mainly as summer range for livestock and wildlife and as woodland. It also serves as a catchment area for water and provides some sites for recreation. Capability unit VIIs–H nonirrigated; High Mountain Stony Loam (Aspen) range site; wildlife group 3141.

Rasband Series

The Rasband series consists of well-drained soils. These soils formed on stream terraces and alluvial fans in alluvium derived mainly from andesite rocks. Slopes range from 1 to 10 percent. The elevation ranges from 5,600 to 6,100 feet. The vegetation is mainly native bluegrasses, needleandthread, western wheatgrass, big sagebrush, squirreltail, bitterbrush, and serviceberry. The average annual precipitation is 18 to 22 inches, the mean annual air temperature is about 44° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is dark grayish-brown loam about 5 inches thick. The subsoil is 31 inches thick. The upper 19 inches is dark grayish-brown loam and heavy loam, and the lower part is brown gravelly loam and gravelly sandy loam. The substratum is brown very gravelly loam coarse sand that extends to a depth of 60 inches. The soil is mainly neutral.

Rasband soils are moderately permeable. The available water capacity is about 6 inches. The water-supplying capacity is 10 to 13 inches. Roots can penetrate to a depth of 48 inches or more.

These soils are used mainly for irrigated crops and as range for livestock and wildlife. Some areas are used for homesites.

Representative profile of Rasband loam, 1 to 3 percent slopes, one-eighth mile west of Heber Fairgrounds, on north side of road, 2,620 feet south and 2,040 feet east of the northwest corner of sec. 6, T. 4 S., R. 5 E. in a cultivated area. Laboratory data available.

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) light loam, very dark brown (10YR 2/3) moist; weak, coarse, subangular blocky structure parting to weak, fine and medium, granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; 10 percent gravel; neutral; clear, smooth boundary.
B1—5 to 12 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, medium, blocky structure; very hard, firm, slightly sticky and slightly plastic; many fine roots; common fine pores; few, thin clay films; neutral; clear, wavy boundary.
B21t—12 to 24 inches, dark grayish-brown (10YR 4/2) heavy loam, dark brown (10YR 3/3) moist; weak, coarse, prismatic structure parting to moderate, medium, blocky; extremely hard, extremely firm, very sticky and very plastic; common fine and medium pores; moderately thick, continuous clay films on peds; 20 percent gravel; neutral; clear, wavy boundary.
B22t—24 to 30 inches, brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; extremely hard, extremely firm, very sticky and very plastic; common fine roots; common very fine pores; thin, patchy clay films on peds; 25 percent gravel; slightly acid; clear, wavy boundary.
B3—30 to 36 inches, brown (10YR 4/3) gravelly sandy loam, dark brown (10YR 3/3) moist; moderate, fine and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; very thin, patchy clay films on peds; 40 percent gravel; neutral; clear, smooth boundary.
C—36 to 60 inches, brown (10YR 5/3) very gravelly loamy coarse sand, dark brown (10YR 3/3) moist; single grained; loose; few fine roots; 70 percent cobbles and gravel; neutral.

The A1 horizon has value of 3 to 5 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 5 to 7 inches thick. The B2t horizon has value of 4 or 5 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 11 to 36 inches thick and ranges from loam to light clay loam that is 5 to 30 percent gravel. The C horizon has value of 2 to 4. It ranges from loamy coarse sand to sand that is more than 50 percent gravel. Some voids 1 millimeter or larger are not filled with fines.

Rasband coarse sandy loam, 3 to 6 percent slopes (RaB).—This soil is mainly on alluvial fans. It has a profile similar to the one described as representative of the series, but the surface layer is coarse sandy loam. Runoff is slow, and the hazard of erosion is slight in nonirrigated areas and moderate in irrigated areas. Included in mapping are small areas of Deer Creek and Manila soils.

This soil is used about equally for irrigated crops and spring and fall range for livestock. Capability units IIIe–3 irrigated, VIe–M nonirrigated; Mountain Loam range site; wildlife groups 2141 and 2141–I.

Rasband coarse sandy loam, 6 to 15 percent slopes (RCC).—This soil is mainly on alluvial fans adjacent to the irrigated valley. It has a profile similar to the one described as representative of the series, but the surface layer is coarse sandy loam. Runoff is medium, and the hazard of erosion is slight in nonirrigated areas and high in irrigated areas. Included in mapping are areas of soils where the surface layer is 20 to 50 percent cobbles.

This soil is used mainly as spring and fall range for livestock, but areas where slopes are 6 to 10 percent are used for irrigated hay and pasture. Capability units IIIe–3 irrigated and VIe–M nonirrigated; Mountain Loam range site; wildlife groups 2141 and 2141–I.

Rasband loam, 1 to 3 percent slopes (RdA).—This soil is mainly on stream terraces adjacent to the

major streams. It has the profile described as representative of the series. Runoff is slow, and the hazard or erosion is slight. Included in mapping are areas of soil that have an undulating topography and soils that have cobbles at a depth of 20 to 30 inches.

Most of the acreage is in irrigated alfalfa, small grain, and pasture. Capability unit IIIc–3 irrigated; wildlife group 2141–I.

Rasband loam, 3 to 10 percent slopes (RdC).—This soil is mainly on the edges of stream terraces and on the transitional areas between different terrace levels. Runoff is medium, and the hazard of erosion is high in irrigated areas and low in nonirrigated areas. Included in mapping are areas of soil that have cobbles at a depth of 20 to 30 inches.

Most of the acreage is in irrigated alfalfa and pasture. Capability unit IIIe–3 irrigated; wildlife group 2141–I.

Rock Land

Rock land (RO) consists of rock outcrop and very thin soil material over bedrock. It occurs in the mountains at elevations of 5,300 to 10,000 feet. Included in mapping are small areas of Bradshaw, Gappmayer, and Wallsburg soils in areas of mixed sedimentary rock; small areas of Lake Janee soils in areas of quartz-diorite porphyry rock; and small areas of Little Pole soils in areas of andesite. Slopes range from 0 to 80 percent or more. The vegetation is chiefly spruce. Composition of the plant community varies with changes in elevation and parent rock. Conifers, curlleaf mountainmahogany, big sagebrush, oakbrush, and bunch grasses are examples of plants that grow in these areas.

Rock land is not suitable for farming. It is used mainly as a catchment area for water, for wildlife, and as sites for recreation. Capability unit VIIIs–X; wildlife group 4444.

Rock Land, Travertine

Rock land, travertine (Rp) is exposed travertine and areas of travertine that are mantled with up to 5 inches of soil material. The vegetation is sparse. Included in mapping are patches of Spaa soils.

Rock land, travertine, is used mainly for riding trails and other nonfarm uses. The travertine rock is used as building material. Capability unit VIIIs–X; wildlife group 4444.

Roundy Series

The Roundy series consists of well-drained soils. These soils formed on mountains and plateaus in residuum derived mainly from mixed sedimentary rocks. Slopes range from 5 to 60 percent. The elevation ranges from 6,500 to 8,500 feet. The vegetation is mainly aspen and scattered spruce and fir and an undergrowth of chokecherry, snowberry, slender wheatgrass, mountain bromegrass, and peavine. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 40° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is about 24 inches thick (fig. 5). The upper 16 inches is dark grayish-brown light loam, and the lower 8 inches is brown very cobbly fine sandy loam. The subsurface layer is pale-brown very cobbly fine sandy loam about 7 inches thick. The subsoil is 23 inches thick. The upper 17 inches is reddish-brown cobbly clay, and the lower part is reddish-yellow very cobbly clay. The surface and subsurface layers are slightly acid. The subsoil is strongly acid.

Roundy soils are slowly permeable. The available water capacity is about 8 inches. The water-supplying capacity is 16 to 18 inches. Roots can penetrate to a depth of 48 inches or more.

These soils are used as summer range for livestock and wildlife and as woodland. They also serve as catchment areas for water and provide some sites for recreation and summer homes.

Representative profile of Roundy loam, 15 to 25 percent slopes, west of Daniels Summit, 1,340 feet north and 90 feet west of southeast corner of sec. 24, T. 5 S., R. 5 E., in a grazable woodland area. Laboratory data available.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, fine, granular

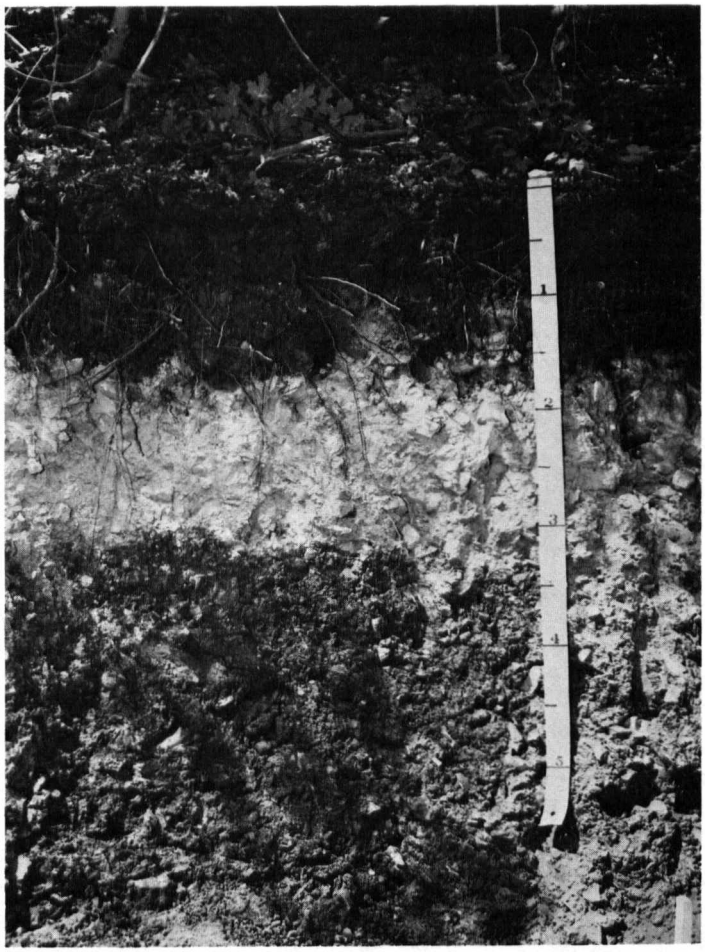

Figure 5.—**Profile of Roundy soil showing thick, dark-colored surface layer, thick, bleached subsurface layer, and dark-colored clay subsoil. The overstory is aspen and some maple.**

structure; soft, very friable; many fine roots; 10 percent gravel; slightly acid; clear, wavy boundary.

A12—2 to 16 inches, dark grayish-brown (10YR 4/2) light loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure parting to weak, fine, subangular blocky; slightly hard, friable; many fine and medium roots; slightly acid; clear, irregular boundary.

A13—16 to 24 inches, brown (10YR 5/3) very cobbly fine sandy loam, dark brown (10YR 3/3) moist; weak, coarse, subangular blocky structure parting to weak, very fine, subangular blocky; hard, friable; many fine and common medium roots; common fine pores; thin, continuous gray coatings on peds; 60 percent gravel, cobbles, and stones; slightly acid; clear, wavy boundary.

A2—24 to 31 inches, pale-brown (10YR 6/3) very cobbly very fine sandy loam, brown (10YR 5/3) moist; weak, medium, subangular blocky structure; hard, brittle, friable; many fine roots; 60 percent gravel, cobbles, and stones; slightly acid; abrupt, wavy boundary.

B21t—31 to 48 inches, reddish-brown (5YR 5/4) cobbly clay, reddish brown (5YR 4/4) crushed, reddish brown (5YR 4/4) moist; strong, coarse, angular blocky structure parting to medium, angular blocky; extremely hard, extremely firm, very sticky and very plastic; few fine, medium, and large roots; thick, continuous clay films on peds; 20 percent cobbles and stones; strongly acid; clear, irregular boundary.

B22t—48 to 54 inches, reddish-yellow (7.5YR 6/6) to reddish-brown (5YR 5/4) very cobbly clay; some ped faces reddish brown (5YR 4/4); strong, blocky structure; thick, continuous clay films on surfaces of peds and rock faces; 70 percent angular sandstone rock fragments; otherwise same as B21t horizon.

The A1 horizon has hue of 10YR ranging to 7.5YR and has value of 3 or 4 when dry and 2 or 3 when moist. It is 12 to 24 inches thick and is mainly loam but is very fine sandy loam in places. Content of gravel and cobbles ranges from 0 to 30 percent. The A2 horizon has hue of 10YR or 7.5YR, value of 5 or 6 when dry and 3 to 5 when moist and chroma of 3 or 4. It is 2 to 9 inches thick and ranges from sandy loam to loam that is 40 to 60 percent gravel and cobbles. The B2t horizon has hue of 5YR to 10YR, value of 5 or 6 when dry and 3 to 5 when moist and chroma of 3 to 6. It is mainly clay, but ranges to heavy clay loam. It is 15 to 35 percent cobbles in the upper part and the percentage increases with increasing depth, becoming fractured bedrock below a depth of 40 inches.

Roundy loam, 5 to 15 percent slopes (RRC).—This soil is mainly on high mountain plateaus and the less steep mountainsides. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of soils where the surface layer is 20 to 50 percent cobbles and soils that have a subsoil of cobbly clay loam.

This soil is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation and summer homes. Capability unit VIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Roundy loam, 15 to 25 percent slopes (RRD).—This soil is mainly on mountains and high mountain plateaus. It has the profile described as representative of the series. Runoff is medium, and the hazard of erosion is slight. Included in mapping are small areas of soils where the surface layer is 20 to 50 percent cobbles and soils that have a subsoil of cobbly clay loam.

This soil is used mainly as summer range for livestock and wildlife and as woodland. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Roundy loam, 25 to 40 percent slopes (RRE).—This soil is on mountainsides. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are small areas of soils where the surface layer is 20 to 70 percent cobbles and areas of Cluff soils under a dense cover of spruce and fir.

This soil is used mainly as summer range for livestock and wildlife and as woodland. It also serves as a catchment area for water. Capability unit VIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Roundy loam, 40 to 60 percent slopes (RRF).—This soil is mainly on very steep mountainsides. Runoff is rapid, and the hazard of erosion is high. Included in mapping are small areas of soils where the surface layer is 20 to 50 percent cobbles and areas of Cluff soils under a dense cover of spruce and fir.

This soil is used mainly as summer range for livestock and wildlife and as woodland. It also serves as a catchment area for water. Capability unit VIIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Roundy-Cluff association, moderately steep (RSC).—This mapping unit is on mountainsides near the crest of the mountain. It is about 70 percent Roundy loam and 20 percent Cluff loam, both of which have slopes of 5 to 15 percent, and about 10 percent other soils. Aspen is the dominant vegetation on the Roundy soil. Spruce and fir are the dominant trees on the Cluff soil. Both soils have profiles similar to the one described as representative of their respective series, but the surface layer of this Cluff loam is less than 20 percent cobbles. Runoff is slow, and the hazard of erosion is slight. Included in mapping are areas of Roundy cobbly loam.

This mapping unit is used mainly as summer range for livestock and wildlife and as woodland. It also serves as a catchment area for water and provides sites for recreation and summer homes. Wildlife group 3141; Roundy soil in capability unit VIe–H nonirrigated and High Mountain Loam (Aspen) range site; Cluff soil in capability unit VIe–HC nonirrigated and woodland.

Roundy-Cluff association, hilly (RSD).—This mapping unit is on mountainsides near the crest of the mountain. It is about 70 percent Roundy loam and 20 percent Cluff loam, both of which have slopes of 15 to 25 percent and about 10 percent other soils. Aspen is the dominant vegetation on the Roundy soil. Spruce and fir are the dominant trees on the Cluff soil. Both soils have profiles similar to the ones described as representative of their respective series, but the surface layer of this Cluff loam is less than 20 percent cobbles. Runoff is medium, and the hazard of erosion is slight. Included in mapping are areas of soils where the surface layer is 20 to 50 percent cobbles.

This mapping unit is used mainly as summer range for livestock and wildlife and as woodland. It also serves as a catchment area for water and provides some sites for recreation. Wildlife group 3141; Roundy soil in capability unit VIe–H nonirrigated and High

Mountain Loam (Aspen) range site; Cluff soil in capability unit VIe–HC nonirrigated and woodland.

Roundy-Daybell association, very steep (RUF).—This mapping unit is on very steep mountainsides. It is about 50 percent Roundy loam, 40 to 60 percent slopes; 20 percent Daybell loam and 20 percent Daybell gravelly loam, both of which have slopes of 40 to 65 percent; and about 10 percent other soils. The soils have no definite pattern of occurrence and are intermingled throughout the landscape. These soils have profiles similar to the ones described as representative of their respective series, but the surface layer of the Daybell gravelly loam is 20 to 50 percent gravel. Runoff is rapid, and the hazard of erosion is high. Included with this unit in mapping are scattered areas of Rock outcrop and areas of Roundy soil where the surface layer is 20 to 50 percent cobbles.

This mapping unit is used mainly as summer range for livestock and wildlife and as woodland. It also serves as a catchment area for water. Wildlife group 3141; High Mountain Loam (Aspen) range site; Roundy soil in capability unit VIIe–H nonirrigated; Daybell soils in capability unit VIIs–H nonirrigated.

Roundy soils, 15 to 25 percent slopes (RYD).—This mapping unit is on mountainsides and in drainages dissecting high mountain plateaus. It is about 60 percent Roundy loam and about 30 percent Roundy cobbly loam, both of which have slopes of 15 to 25 percent, and about 10 percent other soils. Generally these soils are intermingled, and either soil can dominate in a given area. Both soils have profiles similar to the one described as representative of the series, but the surface layer of Roundy cobbly loam is 20 to 50 percent cobbles. Runoff is medium, and the hazard of erosion is slight. Included in mapping are areas of Sessions soils in the open parks.

This mapping unit is used mainly as summer range for livestock and wildlife and as woodland. It also serves as a catchment area for water and provides some sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam (Aspen) range site; wildlife group 3141.

Sessions Series

The Sessions series consists of well-drained soils. These soils formed on ground moraines in mountain areas in glacial drift derived from mixed sedimentary rocks. Slopes range from 5 to 25 percent. The elevation ranges from 8,300 to 9,200 feet. The vegetation is mainly mountain bromegrass, oniongrass, native bluegrasses, bluebell, peavine, and geranium. The average annual precipitation is 25 to 35 inches, the mean annual air temperature is about 40° F, and the frost-free period is less than 50 days.

In a representative profile the surface layer is dark grayish-brown and brown clay loam about 13 inches thick. The subsoil extends to a depth of 61 inches. The upper 41 inches is brown, clay and cobbly light clay. The lower part is brown cobbly sandy clay loam. The surface layer is slightly acid to neutral, and the subsoil is slightly acid to mildly alkaline.

Sessions soils are slowly permeable. The available water capacity is 8 to 9 inches. The water-supplying capacity is 17 to 21 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as summer range for livestock and wildlife. They also serve as catchment areas for water and provide sites for recreation.

Representative profile of Sessions clay loam, 15 to 25 percent slopes, about 17 miles east of Heber, 2,800 feet north and 1,740 feet west of the southeast corner of sec. 36, T. 4 S., R. 6 E. in an area of range. Laboratory data available.

A11—0 to 3 inches, dark grayish-brown (10YR 4/2) clay loam, dark brown (10YR 3/3) moist; weak, fine, granular structure; soft, friable, slightly sticky and plastic; many fine and medium roots; about 10 percent gravel and cobbles; slightly acid; clear, wavy boundary.

A12—3 to 13 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure parting to weak, medium, granular; soft, friable, slightly sticky and plastic; many fine and medium roots; about 20 percent gravel and cobbles; neutral; abrupt, wavy boundary.

B21t—13 to 35 inches, brown (7.5YR 5/3) clay, brown (7.5YR 4/3) moist; moderate, coarse, blocky structure parting to strong, fine and medium, angular blocky; extremely hard, extremely firm, sticky and very plastic; few fine roots; thick, continuous clay films and thin, patchy organic stains on surfaces of peds; about 15 percent cobbles and gravel; slightly acid; gradual, wavy boundary.

B22t—35 to 54 inches, brown (7.5YR 5/4) cobbly light clay, dark brown (7.5YR 4/3) moist; moderate, coarse, blocky structure parting to strong, fine and medium, angular blocky; extremely hard, extremely firm, sticky and very plastic; few fine roots; thick, continuous clay films on surfaces of peds; 25 percent cobbles; slightly acid; clear, wavy boundary.

B3—54 to 61 inches, brown (7.5YR 5/4) cobbly sandy clay loam, brown (7.5YR 4/3) moist; weak, fine, subangular blocky structure; hard, firm, slightly sticky and plastic; few fine roots; thin, patchy clay films on surfaces of peds; 30 percent cobbles; mildly alkaline.

The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 12 to 15 inches thick. The B2t horizon has value of 4 or 5 when dry and 3 or 4 when moist and has chroma of 3 to 5. It ranges from clay to heavy clay loam that is 25 percent cobbles and more than 35 percent clay. It is 25 to 40 inches thick.

Sessions clay loam, 5 to 15 percent slopes (SEC).—This soil is mainly in open grassy areas on ground moraines of the higher mountains. Runoff is slow, and the hazard of erosion is slight. Included with this soil in mapping are small areas of soils where the surface layer is 20 to 50 percent cobbles and wet spots that are shown on the soil map by wet spot symbols.

This soil is used mainly as summer range for livestock and wildlife. It also serves as a catchment area for water and provides sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam range site; wildlife group 3141.

Sessions clay loam, 15 to 25 percent slopes (SED).—This soil is mainly in open grassy areas on ground moraines and lateral moraines of the higher mountains. It has the profile described as representative of the series. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are small areas of soils where the surface layer is 20 to 50 percent cobbles and wet areas that are shown on the soil map by wet spot symbols.

This soil is used mainly as summer range for livestock and wildlife. It also serves as a catchment area

for water and provides some sites for recreation. Capability unit VIe–H nonirrigated; High Mountain Loam range site; wildlife group 3141.

Spaa Series

The Spaa series consists of well-drained, shallow soils. These soils formed on terraces in the vicinity of Midway in residuum from travertine deposits and in alluvium. Slopes range from 2 to 5 percent. The elevation ranges from 5,300 to 5,700 feet. The vegetation is mainly big sagebrush and grasses. The average annual precipitation is 16 to 18 inches, the mean annual air temperature is 45° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is brown heavy silt loam and silt loam about 15 inches thick. The substratum is brown loam about 2 inches thick. This is underlain by layers of irregular masses of travertine at a depth of 17 inches. The soil is mildly to moderately alkaline throughout.

Spaa soils are moderately permeable. The available water capacity is 2 to 3 inches. The water-supplying capacity is 5 to 7 inches. Roots can penetrate to a depth of 20 inches or less.

These soils are used for irrigated pastures and crops.

Representative profile of Spaa silt loam, 2 to 5 percent slopes, 4,900 feet east of Midway Post Office, north of Utah Highway 113, 1,885 feet north and 1,260 feet west of the southeast corner of sec. 35, T. 3 S., R. 4 E., in a cultivated field. Laboratory data available.

Ap—0 to 8 inches, brown (10YR 4/3) heavy silt loam, dark brown (10YR 3/3) moist; weak, coarse, subangular blocky structure parting to moderate, medium and fine, subangular blocky; slightly hard, friable, sticky and slightly plastic; many fine roots; noncalcareous in much of the soil mass; some seams of lime; mildly alkaline; abrupt, smooth boundary.

A12—8 to 15 inches, brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; moderate, coarse and medium, subangular blocky structure; hard, firm, sticky and slightly plastic; common fine roots; noncalcareous in much of the soil mass; some travertine fragments; moderately alkaline; clear, smooth boundary.

C1—15 to 17 inches, brown (10YR 5/3) loam, brown (10YR 4/3) moist; moderate, medium, subangular blocky structure; hard, firm, sticky and slightly plastic; common fine roots; strongly calcareous; moderately alkaline; abrupt, smooth boundary.

R—17 to 18 inches, travertine.

The A1 horizon has value of 4 or 5 when dry and 3 when moist and has chroma of 2 or 3. It is 4 to 15 inches thick. The C horizon has hue of 5YR to 10YR, value of 4 to 7 when dry and 3 or 4 when moist, and chroma of 2 or 3. It is 2 to 6 inches thick and ranges from loam to heavy loam. The underlying travertine is very strongly cemented in most places.

Spaa silt loam, 2 to 5 percent slopes (SpB).—This soil is mainly on terraces. Runoff is slow, and the hazard of erosion is slight in nonirrigated areas and moderate in irrigated areas. Included in mapping are small areas of soils that have undulating topography, small areas of soils that have slopes of 5 to 10 percent, and similar soils that are more than 20 inches deep over travertine.

This soil is used mainly for irrigated pasture and some cultivated crops. Capability unit IVe–33 irrigated; wildlife group 3242–I.

Steed Variant

The Steed variant consists of well-drained, very gravelly soils. These soils formed on flood plains and alluvial fans in alluvium derived from a mixture of rocks. Slopes range from 1 to 3 percent. The elevation ranges from 5,400 to 6,200 feet. The vegetation is mainly Great Basin wildrye, oakbrush, serviceberry, big sagebrush, and Indian ricegrass. The average annual precipitation is 16 to 18 inches, the mean annual air temperature is about 45° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is dark grayish-brown and very dark grayish-brown cobbly loam, loam, and very cobbly loam about 12 inches thick. The substratum is brown very gravelly loamy sand that extends to a depth of 60 inches. The soil is mildly alkaline throughout.

These soils are rapidly permeable. The available water capacity is 2 to 3 inches. The water-supplying capacity is 5 to 7 inches. Roots can penetrate to a depth of 48 inches or more.

These soils are used mainly for irrigated pasture and irrigated crops. They also provide wildlife habitat and sites for recreation.

Representative profile of Steed cobbly loam, cold variant, about 4 miles east of Heber, 1,225 feet west and 360 feet south of northeast corner of sec. 12, T. 4 S., R. 5 E.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) cobbly loam, very dark brown (10YR 2/2) moist; weak, thin and medium, platy structure; soft, very friable and slightly plastic; many fine roots; moderately alkaline; abrupt, smooth boundary.

A12—2 to 7 inches, very dark grayish-brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak, thick, platy structure parting to weak, fine, subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many very fine and few large pores; mildly alkaline; clear, wavy boundary.

A13—7 to 12 inches, very dark grayish-brown (10YR 4/2) very cobbly loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many very fine and few large pores; mildly alkaline; abrupt, wavy boundary.

C–12 to 60 inches, brown (10YR 4/3) very gravelly loamy sand, dark brown (10YR 3/3) moist; single grained; loose; few fine and medium roots; mildly alkaline.

The A1 horizon has value of 3 or 4 when dry and 1 to 3 when moist and has chroma of 2 or 3. It ranges from loam to cobbly loam and is 8 to 12 inches thick. The C horizon has value of 4 or 5 when dry and 2 to 4 when moist and has chroma of 2 to 4. It ranges from very gravelly loamy sand to very gravelly sandy loam to a depth of 40 inches or more.

Steed loam, cold variant (St).—This soil is mainly on flood plains, alluvial fans, and stream terraces. It has a profile similar to the one described as representative of the variant, but its surface layer is less than 20 percent cobbles and gravel. The surface is nearly smooth in most places. Slopes are 1 to 3 percent. Runoff is slow, and the hazard of erosion is slight.

Included with this soil in mapping are small areas of soils where the surface layer is more than 20 percent cobbles, small areas of soils that have undulating topography, and a few areas of soils that have slopes of up to 10 percent.

This soil is used mainly for irrigated alfalfa and irrigated pasture. Capability unit IVs–34 irrigated; wildlife group 3242–I.

Steed cobbly loam, cold variant (Sv).—This soil is mainly on flood plains that have many, small meandering ridges and swales. It has the profile described as representative of the variant. Slopes are 1 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of soils where the surface layer is more than 50 percent cobbles.

Most of the acreage is in irrigated pasture; some is used for irrigated hay. This soil also provides wildlife habitat and sites for recreation. Capability unit IVs–34 irrigated; wildlife group 3242–I.

Van Wagoner Series

The Van Wagoner series consists of well-drained, shallow soils. These soils formed on southerly exposures of mountainsides in residuum derived from quartz-diorite porphyry. Slopes range from 40 to 70 percent. The elevation ranges from 6,300 to 7,200 feet. The vegetation is mainly oakbrush, curlleaf mountainmahogany, big sagebrush, bluebunch wheatgrass, Letterman needlegrass, and balsamroot. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 45° F, and the frost-free period is about 50 to 70 days.

In a representative profile the surface layer is dark grayish-brown cobbly sandy loam about 15 inches thick. The substratum is grayish-brown very cobbly sandy loam about 5 inches thick. Weathered quartz-diorite porphyry bedrock is at a depth of 20 inches. The soil is neutral throughout.

Van Wagoner soils are rapidly permeable. The available water capacity is 1 to 2 inches. The water-supplying capacity is 5 to 7 inches. Roots can penetrate to a depth of 10 to 20 inches.

These soils are used as spring and fall range for livestock and wildlife. They also serve as catchment areas for water and provide some sites for recreation.

Representative profile of Van Wagoner cobbly sandy loam, in an area of Van Wagoner-Rock outcrop complex, 40 to 70 percent slopes, about 3 miles north of Midway, 2,160 feet west and 480 feet north of the southeast corner of sec. 11, T. 3 S., R. 4 E. Laboratory data available.

A11—0 to 1 inch, dark grayish-brown (10YR 4/2) cobbly sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; loose, very friable, slightly sticky and slightly plastic; many fine roots; 15 percent gravel and cobbles; slightly acid; abrupt, wavy boundary.

A12—1 to 15 inches, dark grayish-brown (10YR 4/2) cobbly sandy loam, very dark brown (10YR 2/2) moist; weak, fine, granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; 20 percent cobbles and gravel; neutral; clear, irregular boundary.

C—15 to 20 inches, grayish-brown (10YR 5/2) very cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, slightly sticky; 60 percent weathered quartz-diorite porphyry rock fragments; common fine and medium roots; neutral; clear, wavy boundary.

R—20 inches, weathered quartz-diorite porphyry bedrock.

The A1 horizon has value of 3 or 4 when dry and 1 to 3 when moist and has chroma of 2 or 3. It is 7 to 17 inches thick. The C horizon has value of 4 to 6 when dry and 3 or 4 when moist and has chroma of 2 to 4. It is 6 to 11 inches thick and ranges from light loam to sandy loam that is more than 50 percent cobbles. This soil is 10 to 20 inches deep over quartz-diorite porphyry bedrock.

Van Wagoner-McPhie association, very steep (VMF).—This mapping unit is on very steep mountainsides that are somewhat dissected by canyons. It is about 70 percent Van Wagoner cobbly sandy loam, 40 to 70 percent slopes; 20 percent McPhie cobbly fine sandy loam, 40 to 60 percent slopes; and about 10 percent Rock outcrop. The Van Wagoner soil is on the south exposures and the McPhie soil is on the east exposures of the canyons and drainages. Both soils have profiles similar to the ones described as representative of their respective series, but the surface layer of McPhie cobbly fine sandy loam is 20 to 50 percent cobbles. Runoff is rapid, and the hazard of erosion is high. The hazard of soil blowing is moderate. Included with this unit in mapping are small areas of Rock outcrop and some deep soils.

This mapping unit is used mainly as range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Van Wagoner soil in capability unit VIIs–M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343; McPhie soil in capability unit VIIe–M nonirrigated, Mountain Gravelly Loam (Oakbrush) range site, wildlife group 3141.

Van Wagoner-Rock outcrop complex, 40 to 70 percent slopes (VWF).—This mapping unit is on very steep mountainsides that have a southerly exposure. It is about 70 percent Van Wagoner cobbly sandy loam, 40 to 70 percent slopes, 20 percent Rock outcrop, and about 10 percent other soils. The rock outcrops are areas of quartz-diorite porphyry occurring as ledges and barren rock. They are scattered throughout the area of Van Wagoner soil. The Van Wagoner soil has the profile described as representative of the series. Runoff is rapid, the hazard of erosion is high. The hazard of soil blowing is moderate. Included in mapping are small areas of soil where the surface layer is less than 20 percent cobbles.

This mapping unit is used mainly as range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Van Wagoner soil in capability unit VIIs–M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343; Rock outcrop in capability unit VIIIs–X, wildlife group 4444.

Wallsburg Series

The Wallsburg series consists of well-drained shallow soils. These soils formed on mountainsides in residuum derived from mixed sedimentary rocks. Slopes range from 20 to 60 percent. The elevation ranges from 5,500 to 7,000 feet. The vegetation is mainly big sagebrush, birchleaf mountainmahogany, bluebunch wheatgrass, native bluegrasses, snowberry, and oakbrush. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 44° F, and the frost-free period is 50 to 70 days.

In a representative profile the surface layer is dark grayish-brown very cobbly very fine sandy loam and very cobbly sandy clay loam about 8 inches thick. The subsoil is brown very cobbly heavy clay loam about 4 inches thick. Fractured sandstone bedrock is at a depth of 12 inches. The soil is neutral throughout.

Wallsburg soils are moderately slowly permeable. The available water capacity is 1 to 2 inches, depending on depth to the bedrock. The water-supplying capacity is 3 to 6 inches. Roots can penetrate to a depth of 9 to 20 inches.

These soils are used as range for livestock and wildlife. They also serve as catchment areas for water.

Representative profile of Wallsburg very cobbly sandy clay loam in an area of Wallsburg-Rock outcrop complex, 20 to 60 percent slopes, about 10 miles southwest of Heber, 1,840 feet south and 360 feet west of the northeast corner of sec. 1, T. 5 S., R. 4 E. in an area of range. Laboratory data available.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) very cobbly very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium, granular structure; soft, very friable, slightly sticky and slightly plastic; many fine roots; 65 percent cobbles, gravel, and stones; neutral; abrupt, wavy boundary.

A12—2 to 8 inches, dark grayish-brown (10YR 4/2) very cobbly sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium and fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; common fine and medium pores; 65 percent cobbles and stones; neutral; clear, wavy boundary.

B2t—8 to 12 inches, brown (7.5YR 4/3) very cobbly heavy clay loam, dark brown (7.5YR 3/3) moist; weak, medium, subangular blocky structure parting to moderate, fine, subangular blocky, very hard, firm, sticky and plastic; common fine and medium roots; few fine and medium pores; thin, patchy clay films; 65 percent cobbles and stones; neutral; clear, irregular boundary.

R—12 inches, fractured sandstone bedrock.

Depth to bedrock ranges from 9 to 20 inches. The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist and has chroma of 2 or 3. It is 5 to 11 inches thick. The Bt horizon has value of 4 to 5 when dry and 2 or 3 when moist and has chroma of 2 to 6. It is 4 to 6 inches thick and ranges from very cobbly heavy clay loam and very cobbly clay that is more than 35 percent clay and more than 50 percent cobbles.

Wallsburg-Rock outcrop complex, 20 to 60 percent slopes (WBF).—This mapping unit is on southerly exposures of mountainsides. It is about 70 percent Wallsburg very cobbly sandy clay loam, 20 to 60 percent slopes, 20 percent Rock outcrop, and 10 percent other soils. The Rock outcrop is mainly sandstone and quartzite that occurs as ledges and as Rock land that has less than 4 inches of soil mantle. Runoff is very rapid, and the hazard of erosion is high. Included in mapping are small areas of soil lacking a subsoil, pockets of soil deeper than 20 inches over bedrock, and in places small areas of Gappmayer soils.

This mapping unit is used mainly as spring and fall range for livestock and as winter range for wildlife. It also serves as an important catchment area for water. Wallsburg soil in capability unit VIIs–M nonirrigated, Mountain Shallow Loam range site, wildlife group 4343; Rock outcrop in capability unit VIIIs–X; wildlife group 4444.

Watkins Ridge Series

The Watkins Ridge series consists of well-drained soils. These soils formed on alluvial fans, ridges, and knolls of the lower mountains in alluvium derived from mixed sedimentary rocks. Slopes range from 6 to 25 percent. The elevation ranges from 5,400 to 6,000 feet. The vegetation is mainly big sagebrush, bitterbrush, oakbrush, western wheatgrass, Indian ricegrass, balsamroot, and lupine. The average annual precipitation is 16 to 18 inches, the mean annual air temperature is about 44° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is dark grayish-brown silt loam and cobbly heavy silt loam about 12 inches thick. The substratum extends to a depth of about 60 inches. The upper 8 inches is pale-brown cobbly clay loam, and the lower part is very pale brown and pink loam and light clay loam. The soil is mildly alkaline throughout.

Watkins Ridge soils are moderately permeable. The available water capacity is about 10 inches. The water-supplying capacity is 12 to 14 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as spring and fall range for livestock and wildlife. They also serve as catchment areas for water and provide some sites for recreation and homes.

Representative profile of Watkins Ridge silt loam, 6 to 15 percent slopes, about 10 miles south of Heber, 2,200 feet west and 75 feet south of the northeast corner of sec. 35, T. 4 S., R. 5 E. in an area of range. Laboratory data available.

A11—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak, thick, platy structure parting to weak, fine, granular; soft, very friable, slightly plastic; many fine roots; common medium and large pores; noncalcareous, few fine lime fragments; mildly alkaline; clear, wavy boundary.

A12—4 to 12 inches, dark grayish-brown (10YR 4/2) cobbly heavy silt loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure parting to moderate, medium, granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; common fine and medium pores; 30 percent cobbles; slightly calcareous; mildly alkaline; clear, wavy boundary.

C1ca—12 to 20 inches, pale-brown (10YR 6/3) cobbly clay loam, brown (10YR 4/3) moist; weak, coarse, subangular blocky structure parting to medium and fine, subangular blocky; hard, firm, slightly sticky and slightly plastic; many fine roots; common fine and medium pores; 30 percent cobbles; strongly calcareous; mildly alkaline; clear, wavy boundary.

C2ca—20 to 34 inches, very pale brown (10YR 8/3) loam, pale brown (10YR 6/3) moist; massive; weakly cemented; slightly sticky and slightly plastic; few fine roots; strongly calcareous; mildly alkaline; gradual, wavy boundary.

C3ca—34 to 46 inches, pink (7.5YR 8/5) loam, light brown (7.5YR 6/5) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; very strongly calcareous; moderately alkaline; gradual, wavy boundary.

C4ca—46 to 60 inches, pink (7.5YR 7/4) light clay loam, yellowish brown (10YR 5/4) moist; massive; soft, friable, slightly sticky and slightly plastic; very strongly calcareous; mildly alkaline.

The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist and has chroma of 1 or 2. It is 7 to 13 inches thick. The Cca horizon has hue of 10YR and 7.5YR, value of 6 to 8 when dry and 4 to 6 when moist, and chroma of 2 or 3. It is 30

to 50 inches thick and ranges from loam to clay loam that is 0 to 30 percent cobbles. In places thin layers are cemented with lime.

Watkins Ridge silt loam, 6 to 15 percent slopes (WcC).—This soil is mainly on alluvial fans and foothills. It has the profile described as representative of the series. Runoff is medium, and the hazard of erosion is slight in nonirrigated areas and high in irrigated areas. Included in mapping are small areas of a similar soil that has slopes of less than 6 percent and soils where the surface layer is 20 to 50 percent cobbles.

This soil is used mainly as range for livestock and wildlife. Some areas of soils that have slopes of 6 to 10 percent are in irrigated pasture and hay. Capability units IIIe–3 irrigated and VIe–U nonirrigated; Upland Loam range site; wildlife groups 2141 and 2141–I.

Watkins Ridge silt loam, 15 to 25 percent slopes (WcD).—This soil is mainly on alluvial fans and foothills. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are small areas of a soil that has slopes of less than 15 percent, areas of soil where the surface layer is 20 to 50 percent cobbles, and small areas of soil where the surface layer has been eroded away.

This soil is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Capability unit VIe–U nonirrigated; Upland Loam range site; wildlife group 2141.

Watkins Ridge-Clegg complex, 6 to 15 percent slopes (WLC).—This mapping unit is mainly on old alluvial fans that are dissected by drainageways. It is about 55 percent Watkins Ridge silt loam and 35 percent Clegg loam, both of which have slopes of 6 to 15 percent, and about 10 percent other soils. The Watkins Ridge soil is mainly on the ridges and knolls, and the Clegg soil is in the swales and depressions. Runoff is medium, and the hazard of erosion is slight. Included in mapping are small areas of a soil that has slopes of less than 6 percent and areas of soil where the surface layer is 20 to 50 percent cobbles.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. Capability unit VIe–U nonirrigated; Upland Loam range site; wildlife group 2141.

Watkins Ridge-Clegg complex, 15 to 25 percent slopes (WLD).—This mapping unit is on old alluvial fans that are dissected by drainageways. It is about 55 percent Watkins Ridge silt loam and 35 percent Clegg loam, both of which have slopes of 15 to 25 percent, and about 10 percent other soils. The Watkins Ridge soil is mainly on the ridges, and the Clegg soil is in the swales and depressions. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are small patches of soil where the surface layer is 20 to 50 percent cobbles.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Capability unit VIe–U nonirrigated; Upland Loam range site; wildlife group 2141.

Watkins Ridge-Deer Creek complex, 6 to 15 percent slopes (WNC).—This mapping unit is mainly on alluvial fans. It is about 55 percent Watkins Ridge silt loam and 35 percent Deer Creek loam, both of which have slopes of 6 to 15 percent, and about 10 percent other soils. The Watkins Ridge soil is on the ridges and in convex areas, and the Deer Creek soil is in the concave areas and swales. Runoff is medium, and the hazard of erosion is slight. Included in mapping are small areas of similar soils that have slopes of less than 6 percent and intermingled patches of soils where the surface layer is 20 to 50 percent cobbles.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also provides some sites for recreation. Capability unit VIe–U nonirrigated; Upland Loam range site; wildlife group 2141.

Watkins Ridge-Deer Creek complex, 15 to 25 percent slopes (WND).—This mapping unit is on steep old alluvial fans and mountain foot slopes. It is about 55 percent Watkins Ridge silt loam and 35 percent Deer Creek loam, both of which have slopes of 15 to 25 percent, and about 10 percent other soils. The Watkins Ridge soil is mainly on the ridges and in convex areas. The Deer Creek soil is mainly in the swales and on the concave areas. The Watkins Ridge soil has a profile similar to the one described as representative of the series. The Deer Creek soil has the profile described as representative of the Deer Creek series. Runoff is medium, and the hazard of erosion is moderate. Included with this unit in mapping are small areas of similar soils that have slopes of 25 to 40 percent and patches of soils where the surface layer is 20 to 50 percent cobbles.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Capability unit VIe–U nonirrigated; Upland Loam range site; wildlife group 2141.

Whipstock Series

The Whipstock series consists of well-drained soils. These soils formed on mountainsides and alluvial fans in alluvium and residuum derived from mixed sedimentary rocks. Slopes range from 6 to 60 percent. The elevation ranges from 5,600 to 6,800 feet. The vegetation is mainly big sagebrush, oakbrush, native bluegrasses, bluebunch wheatgrass, and western wheatgrass. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 43° F, and the frost-free period is about 50 to 70 days.

In a representative profile the surface layer is about 21 inches thick. The upper 10 inches is dark grayish-brown cobbly loam and cobbly heavy loam, and the lower 11 inches is brown cobbly light clay loam. The subsoil extends to a depth of about 59 inches. The upper 28 inches is light reddish-brown cobbly heavy clay, and the lower part is light reddish-brown cobbly heavy clay with veins, splotches, and pockets of lime accumulation. The substratum is pink very cobbly clay that extends to a depth of 69 inches. The soil is slightly acid in the top 37 inches and neutral to mildly alkaline below.

Whipstock soils are slowly permeable. The available water capacity is about 8 inches. The water-supplying capacity is 12 to 15 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as range for livestock and wildlife. They also serve as catchment areas for water and provide some sites for recreation.

Representative profile of Whipstock cobbly loam in an area of Whipstock soils, 6 to 15 percent slopes, about 15 miles southeast of Heber, 400 feet west and 65 feet north of the southeast corner of sec. 32, T. 5 S., R. 5 E. in an area of range. Laboratory data available.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) cobbly loam, very dark brown (10YR 2/2) moist; moderate, medium, granular structure; soft, friable, slightly sticky and plastic; many fine and medium roots; 35 percent cobbles and gravel; neutral; abrupt, smooth boundary.

A12—2 to 10 inches, dark grayish-brown (10YR 4/2) cobbly heavy loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine and medium pores; 35 percent cobbles and gravel; slightly acid; clear, wavy boundary.

A3—10 to 21 inches, brown (7.5YR 5/4) cobbly light clay loam, dark brown (7.5YR 3/4) moist; moderate, coarse, subangular blocky structure parting to medium, subangular blocky; very hard, firm, sticky and plastic; many fine and medium roots; many fine and medium pores; thin clay films as bridges between sand grains; 35 percent cobbles and gravel; slightly acid; abrupt, smooth boundary.

B21t—21 to 37 inches, light reddish-brown (5YR 6/4) cobbly heavy clay, reddish brown (5YR 4/4) moist; strong, coarse, angular blocky structure parting to medium, angular blocky; extremely hard, extremely firm, very sticky and very plastic; common fine and few medium roots; few fine pores; thick, continuous clay films on peds; 20 percent cobbles and gravel; common, small, dark concretions; slightly acid; clear, wavy boundary.

B22t—37 to 49 inches, light reddish-brown (5YR 6/4) cobbly heavy clay, reddish brown (5YR 4/4) moist; strong, coarse, angular blocky structure parting to medium, angular blocky; extremely hard, extremely firm, very sticky and very plastic; common fine and few medium roots; few fine pores; few thin organic stains; thick, continuous clay films; 25 percent cobbles; moderately calcareous; neutral; clear, wavy boundary.

B23tca—49 to 59 inches, same as B22t horizon except has veins, splotches, and pockets of lime accumulation; 40 percent cobbles; clear, wavy boundary.

Cca—59 to 69 inches, pink (5YR 7/3) very cobbly clay, reddish brown (5YR 5/4) moist; massive; hard, firm, sticky and plastic; few fine roots; 70 percent cobbles and gravel; strongly calcareous; mildly alkaline.

The A horizon has hue of 10YR and 7.5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3. It is 8 to 15 inches thick. The B2t horizon has value of 5 or 6 when dry and 4 when moist and has chroma of 3 or 4. It is 6 to 40 inches thick and is heavy clay that is more than 60 percent clay. Content of cobbles ranges from 0 to 35 percent.

Whipstock very cobbly loam, 15 to 60 percent slopes (WPF).—This soil is mainly on mountainsides and alluvial fans. It has a profile similar to the one described as representative of the series, but its surface layer is more than 50 percent cobbles. Runoff is rapid, and the hazard of erosion is high. Included in mapping are small areas of Whipstock soils where the surface layer is less than 50 percent cobbles.

This soil is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Capability unit VIIs–M nonirrigated; Mountain Stony Loam range site; wildlife group 3141.

Whipstock soils, 6 to 15 percent slopes (WSC).—This mapping unit is mainly on alluvial fans. It is about 60 percent Whipstock loam and 30 percent Whipstock cobbly loam, both of which have slopes of 6 to 15 percent, and about 10 percent other soils. Generally these soils are intermingled, and either soil can dominate in a given area. Whipstock cobbly loam has the profile described as representative of the series. Whipstock loam has a similar profile, but its surface layer is less than 20 percent cobbles. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of Whipstock soils that have slopes of less than 6 percent and some areas of Whipstock very cobbly loam.

This mapping unit is used mainly as spring and fall range for livestock. It also serves as a catchment area for water and provides some sites for recreation. Capability unit VIe–M nonirrigated; Mountain Loam range site; wildlife group 2141.

Whipstock soils, 15 to 25 percent slopes (WSD).—This mapping unit is mainly on alluvial fans. It is about 60 percent Whipstock loam and 30 percent Whipstock cobbly loam, both of which have slopes of 15 to 25 percent, and about 10 percent other soils. Generally these soils are intermingled, and either soil can dominate in a given area. Both soils have profiles similar to the one described as representative of the series, but the surface layer of Whipstock loam is less than 20 percent cobbles. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are small areas of Whipstock soils that have slopes of less than 15 percent and patches of soil where the surface layer is more than 50 percent cobbles.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. Capability unit VIe–M nonirrigated; Mountain Loam range site; wildlife group 2141.

Whipstock soils, 25 to 40 percent slopes (WSE).—This mapping unit is on mountainsides. It is mainly Whipstock loam and Whipstock cobbly loam, both of which have slopes of 25 to 40 percent, and about 10 percent other soils. Generally these soils are intermingled, and either soil can dominate in a given area. The Whipstock cobbly loam is in patches intermingled with Whipstock loam. Both soils have profiles similar to the one described as representative of the series, but the surface layer of Whipstock loam is less than 20 percent cobbles. Runoff is rapid, and the hazard of erosion is slight. Included in mapping are small areas of Whipstock soils that are steeper and small areas of soil where the surface layer is more than 50 percent cobbles.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. Capability unit VIe–M nonirrigated; Mountain Loam range site; wildlife group 2141.

Yeates Hollow Series

The Yeates Hollow series consists of well-drained soils. These soils formed on alluvial fans in alluvium derived from mixed sedimentary rocks. Slopes range from 2 to 25 percent. The elevation ranges from 5,500 to 6,700 feet. The vegetation is mainly oakbrush, big

sagebrush, bitterbrush, snowberry, native bluegrasses, and wheatgrasses. The average annual precipitation is 18 to 25 inches, the mean annual air temperature is about 43° F, and the frost-free period is about 70 to 90 days.

In a representative profile the surface layer is dark grayish-brown very cobbly loam about 9 inches thick. The subsoil extends to a depth of 60 inches. The upper 3 inches is brown very cobbly clay loam. The next 14 inches is reddish-brown very cobbly sandy clay, and the lower 34 inches is reddish-brown and brown cobbly and very cobbly clay. The surface layer is neutral, the upper part of the subsoil is slightly acid, and the lower part of the subsoil is neutral.

Yeates Hollow soils are slowly and very slowly permeable. The available water capacity is 5 to 6 inches. The water-supplying capacity is 10 to 13 inches. Roots can penetrate to a depth of 60 inches or more.

These soils are used as spring and fall range for livestock and wildlife. In places they are being developed as sites for summer homes. They also serve as catchment areas for water.

Representative profile of Yeates Hollow very cobbly loam, 6 to 15 percent slopes, about 10 miles southwest of Heber, 2,220 feet north and 1,400 feet east of the southwest corner of sec. 5, T. 5 S., R. 5 E. in an area of range:

A11—0 to 4 inches, dark grayish-brown (10YR 4/2) very cobbly loam, very dark brown (10YR 2/2) moist; weak, thick, platy structure parting to moderate, fine, granular; soft, very friable, slightly sticky and slightly plastic; many fine roots; neutral; clear, smooth boundary.

A12—4 to 9 inches, dark grayish-brown (10YR 4/2) very cobbly loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure parting to moderate, coarse, granular; soft, friable, slightly sticky and slightly plastic; many fine and medium roots; many fine pores; neutral; clear, broken boundary.

B1—9 to 12 inches, brown (7.5YR 4/3) very cobbly clay loam, dark brown (7.5YR 3/3) moist; weak, medium, subangular blocky structure parting to moderate, fine, subangular blocky; hard, firm, sticky and plastic; common fine and medium roots; common fine pores; thin, patchy clay films on peds; slightly acid; abrupt, wavy boundary.

B21t—12 to 26 inches, reddish-brown (5YR 4/4) very cobbly sandy clay, dark reddish brown (5YR 3/4) moist; moderate, very coarse, angular blocky structure parting to strong, fine and medium, angular blocky; extremely hard, extremely firm, very sticky and very plastic; common fine roots; few fine pores; thin, continuous clay films on peds; slightly acid; clear, wavy boundary.

B22t—26 to 36 inches, reddish-brown (5YR 5/4) cobbly clay, reddish brown (5YR 4/4) moist; moderate, very coarse, angular blocky structure parting to strong, fine and medium, angular blocky; extremely hard, extremely firm, very sticky and very plastic; few fine roots; few fine pores; moderately thick, continuous clay films on peds; slightly acid; clear, irregular boundary.

B23t—36 to 60 inches, brown (7.5YR 5/4) very cobbly clay, brown (7.5YR 4/4) moist; moderate, very coarse, angular blocky structure parting to strong, fine and medium, angular blocky; extremely hard, extremely firm, very sticky and very plastic; few fine roots; few fine pores; moderately thick, continuous clay films on peds; neutral.

The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist. It is 8 to 13 inches thick. The B2t horizon has hue of 5YR and 7.5YR, value of 4 to 6 when dry and 3 to 5 when moist, and chroma of 3 or 4. It is 20 to 40 inches thick and ranges from sandy clay to clay that is 50 to 85 percent cobbles and gravel. Faint mottles occur between depths of 30 and 50 inches in some places.

Yeates Hollow loam, 2 to 5 percent slopes (YaB).—This soil is mainly on alluvial fans. It has a profile similar to the one described as representative of the series, but its surface layer is less than 20 percent cobbles. Runoff is slow, and the hazard of erosion is slight. Included in mapping are small areas of a similar soil that has slopes of 5 to 20 percent and small areas of Yeates Hollow very cobbly loam.

Most of the acreage is in irrigated alfalfa, small grain, and pasture. Capability unit IIIe–3 irrigated; wildlife group 2141–I.

Yeates Hollow very cobbly loam, 6 to 15 percent slopes (YEC).—This soil is mainly on alluvial fans. It has the profile described as representative of the series. Runoff is medium, and the hazard of erosion is slight. Included in mapping are small areas of a similar soil that has slopes of less than 6 percent and soils where the surface layer is 20 to 50 percent cobbles.

This soil is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation. In places it is being developed as sites for summer homes. Capability unit VIIs–M nonirrigated; Mountain Stony Loam range site; wildlife group 2141.

Yeates Hollow very cobbly loam, 15 to 25 percent slopes (YED).—This soil is mainly on alluvial fans and mountain foot slopes. Runoff is medium, and the hazard of erosion is moderate. Included in mapping are similar soils where the surface layer is less than 50 percent cobbles.

This soil is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation and summer homes. Capability unit VIIs–M nonirrigated; Mountain Stony Loam range site; wildlife group 2141.

Yeates Hollow-Henefer association, moderately steep (YTC).—This mapping unit is on alluvial fans and mountainsides. It is about 55 percent Yeates Hollow very cobbly loam, 6 to 15 percent slopes; 35 percent Henefer silt loam, 6 to 10 percent slopes; and about 10 percent other soils. The soils are intermingled and are in no definite pattern on the landscape. Runoff is medium, and the hazard of erosion is slight. Included in mapping are small areas of Henefer cobbly silt loam and Yeates Hollow cobbly loam.

This mapping unit is used mainly as spring and fall range for livestock and wildlife. It also serves as a catchment area for water and provides some sites for recreation and summer homes. Yeates Hollow soil in capability unit VIIs–M nonirrigated, Mountain Stony Loam range site, wildlife group 2141; Henefer soil in capability unit VIe–M nonirrigated, Mountain Loam range site, wildlife group 2141.

Yeates Hollow-Henefer association, hilly (YTD).—This mapping unit is on alluvial fans and mountainsides. It is about 55 percent Yeates very cobby loam, 15 to 25 percent slopes; 35 percent Henefer silt loam, 10 to 25 percent slopes, and about 10 percent other soils. The soils are intermingled and are in no definite pattern on the landscape. Runoff is medium, and the

hazard of erosion is moderate. Included in mapping are small areas of Henefer cobbly silt loam and Yeates Hollow cobbly loam.

This mapping unit is used mainly as spring and fall range for livestock. It also serves as a catchment area for water and provides some sites for recreation. Wildlife group 2141; Yeates Hollow soil in capability unit VIIs–M nonirrigated, Mountain Stony Loam range site; Henefer soil in capability unit VIe–M nonirrigated; Mountain Loam range site.

Use and Management of the Soils

The soils of the Heber Valley Area are used chiefly for irrigated crops, irrigated pasture, and range and to some extent for woodland. This section tells how the soils can be managed for these purposes. A table shows estimated yields per acre of the principal irrigated crops. This section also suggests management of the soils for engineering purposes, recreation, and wildlife.

Management for Crops

Crop management and estimated yield in this survey are based on farm records and observations made by the district conservationist and soil scientists who worked on the survey. If little or no information was available for a particular soil, yield estimates were made by comparison with similar soils.

The cultivated and irrigated soils occur in areas where the frost-free period is only 70 to 90 days. This short growing season limits the crops that can be grown. Principal crops are alfalfa, alfalfa-grass mixture, small grain, and irrigated pasture.

Land leveling, tillage, irrigation water management, drainage, fertilization, pest control, and weed control are the important management needs.

Information concerning land leveling, tillage, water management, and drainage can be obtained in the field office of the Soil Conservation Service.

Rapid changes in technology and better materials make it undesirable to give specific trade names and crop varieties. The most up-to-date suggestions can be obtained from the Utah State University Experiment Station and Extension Service for fertilizers, crop varieties, insecticides, and weedicides.

Organic matter contains appreciable amounts of nitrogen and lesser amounts of phosphorus and other essential plant nutrients. It is a source of energy for the micro-organisms that inhabit the soil and aids these organisms in making important nutrients available to plants.

Barnyard manure adds organic matter to the soil. It also provides organic agents that aggregate soil particles, improving soil structure.

All crop residue incorporated into the soil increases the level of organic matter. Fertilizers added in sufficient quantities to produce high crop yields in turn increase the amount of crop residue produced.

Grasses have an abundant and finely fibrous root system that is well distributed throughout the upper part of the soil. The slow decay of the roots improves soil structure and binds the soil particles, thus protecting the soil against erosion.

The objectives of tillage are incorporating crop residue, improving soil aeration, and destroying weeds. Tillage should be held to a minimum. Plowing should be done in the fall. Freezing and thawing during the winter mellow the clods and make the soil friable.

Almost all of the irrigated soils need varying amounts of leveling. Leveling correctly done and properly maintained provides a uniform distribution of irrigation water.

Crops in this Area will respond to the application of fertilizers. All crops except legumes benefit from the application of nitrogen. Legumes generally respond to phosphorus.

There are no known deficiencies of potassium, calcium, iron, or magnesium.

On most well-managed, irrigated soils erosion is not a hazard unless the slope is greater than 3 percent. Small streams, short irrigation runs, and an alfalfa-grass mixture are effective erosion control measures.

Essentially all the irrigation water in this Area is good quality. Mostly it is diverted from natural streamflow and is available early in the growing season. A lesser amount is available later in the season.

The water requirements of crops are low early in the growing season, reach a peak in July, and then drop off toward the end of the season. The average growing season is from June 14 to September 5.

Irrigated pasture is fertilized with 75 to 100 pounds each of phosphate and nitrogen every 2 to 4 years. Pastures are fenced into strips and an electric fence is moved each day to provide the cattle with a grazing area just large enough to last them for 1 day. Each pasture is completely grazed (fig. 6) every 28 to 30 days. Pastures are not grazed while the soil is wet enough to pack. When necessary, pastures are clipped to a height of 4 to 6 inches after grazing to keep the forage growth uniform. Livestock droppings are scattered once in the spring. Pastures are not grazed in the spring until the plants reach a height of 8 to 10 inches. At least 4 inches of plant growth is left after each grazing period and after grazing in the fall.

The kind of soil on which the pasture is to be established is taken into consideration when deciding on the mixture to be seeded. Pastures are seeded in the spring to a mixture of one legume and one or two grasses. Pastures are not grazed the year that they are seeded.

Table 2 shows yield estimates for the principal crops under a high level of management. A representative rotation is 6 to 7 years in a grass-legume mixture followed by 2 years in small grain. The second year the grain serves as a companion crop.

New seedings of alfalfa-grass are fertilized with 80 to 120 pounds of phosphate every 2 to 4 years until the alfalfa is plowed up. Fields are leveled and irrigation runs are designed according to the water-holding capacity and intake rate of the soils.

Capability Grouping

Capability classification is a grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of soils, the risk of damage when they

Figure 6.—**Cattle grazing a well-managed, irrigated pasture.**

are used, and the way they respond to treatment. The soils are classified according to degree and kind of permanent limitations, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible but unlikely major reclamation projects.

In the capability system, all kinds of soil are grouped at three levels, the capability class, the subclass, and the unit. These are described in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. Classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have limitations that reduce the choice of plants, require very careful management, or both.

Class III soils have severe limitations that reduce the choice of plants, require very careful management, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI soils have severe limitations that generally make them unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Class VII soils have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial crops and restrict their use to recreation, wildlife, water supply, or to esthetic purposes.

TABLE 2.—*Estimated yields per acre of principal irrigated crops*

[Yields are those to be expected over a period of years under good management. Absence of a yield figure means that the soil is generally considered unsuitable for the specified crop]

Soil	Alfalfa	Alfalfa-grass	Barley	Irrigated pasture
	Tons	*Tons*	*Bushel*	*Cow-acre-days* [1]
Bezzant cobbly loam, 10 to 20 percent slopes, eroded		2.0		125
Bezzant very cobbly loam, 6 to 10 percent slopes				150
Broadhead soils, 6 to 15 percent slopes		4.0	75	225
Center Creek loam	4.5	4.0	85	250
Clegg loam, 1 to 3 percent slopes	4.5	4.0	85	250
Clegg loam, 3 to 6 percent slopes	4.5	4.0	85	250
Clegg loam, 6 to 15 percent slopes		4.0	80	250
Clegg cobbly loam, 5 to 10 percent slopes		3.5	65	200
Crooked Creek clay loam, 1 to 3 percent slopes		2.5	70	175
Crooked Creek clay loam, 3 to 10 percent slopes		2.0		125
Cudahy silt loam, cold variant		3.0		175
Cudahy silt loam, cold variant, moderately deep water table		2.5		150
Deer Creek loam, 1 to 3 percent slopes	4.5	4.0	85	250
Deer Creek loam, 3 to 10 percent slopes	4.5	4.0	80	250
Henefer silt loam, 1 to 3 percent slopes	4.5	4.0	85	250
Henefer silt loam, 6 to 10 percent slopes		4.0	75	225
Henefer silt loam, 10 to 25 percent slopes		3.0	55	150
Holmes cobbly sandy loam	3.0	3.0	65	150
Holmes cobbly sandy loam, channeled	2.5	2.5	60	125
Holmes very cobbly sandy loam				100
Holmes gravelly loam	4.0	3.5	80	200
Kovich loam		4.0	70	225
Kovich loam, channeled		4.0	70	225
Kovich loam, moderately deep water table		4.0	70	225
Kovich loam, deep water table variant	4.5	4.0	85	225
Kovich loam, gravelly subsoil variant		4.0	70	225
Kovich loam, gravelly subsoil variant, channeled		4.0	70	225
Kovich loam, gravelly subsoil variant, moderately deep water table		4.0	70	225
Logan silty clay, cold variant		3.5	65	225
Manila silt loam, 3 to 6 percent slopes	4.5	4.0	75	250
Manila silt loam, 6 to 10 percent slopes		4.0	75	225
Manila silt loam, 10 to 20 percent slopes		3.0	55	150
Rasband coarse sandy loam, 3 to 6 percent slopes	4.5	4.0	85	250
Rasband coarse sandy loam, 6 to 15 percent slopes		4.0	80	225
Rasband loam, 1 to 3 percent slopes	4.5	4.0	85	250
Rasband loam, 3 to 10 percent slopes	4.5	4.0	80	250
Spaa silt loam, 2 to 5 percent slopes		2.5		150
Steed loam, cold variant		3.0	65	100
Steed cobbly loam, cold variant				100
Watkins Ridge silt loam, 6 to 15 percent slopes		3.5	65	200
Watkins Ridge silt loam, 15 to 25 percent slopes				75
Yeates Hollow loam, 2 to 5 percent slopes		3.0	65	150

[1] Cow-acre-days is a term used to express the carrying capacity of pasture. It is the number of animal units carried per acre multiplied by the number of days the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that provides 30 days of grazing for two cows has a carrying capacity of 60 cow-acre-days.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows the water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* shows that the chief limitation is a climate that has a short frost-free season or is short of moisture.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making statements about the management of soils. Capability units are generally designated by adding numbers, or letters, assigned locally. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the Utah system a number or letter is used to suggest the chief kind of limitation. Numbers are used for irrigated capability units and letters for nonirrigated capability units. For example, for irrigated soils the numeral 3 following the hyphen indicates a frost-free period for 70 to 100 days. A second number, in only some units, indicates additional limitations. The numeral 3, for example, indicates re-

stricted depth, 4 coarse fragments below the surface, and 5 restricted permeability.

For nonirrigated soils the letter following the hyphen indicates annual precipitation. The letter *H* indicates 25 to 35 inches; *M*, 18 to 25 inches; and *U*, 14 to 18 inches.

A second letter following the hyphen, in this survey the letter *C*, indicates spruce-fir woodland.

Some miscellaneous lands are in Class VIII, subclass *s*. The letter *X* following the hyphen indicates shallow, stony, or rocky material.

Management by capability units

Soils in the Heber Valley Area are grouped into capability units. Those grouped together have similar characteristics and qualities. Irrigated soils are grouped based on the assumption that irrigation water is available for all soils and that drainage and irrigation water control are potentially feasible to the same degree.

Nonirrigated soils are used principally as catchment areas for water, as sites for recreation, and for wildlife and livestock grazing. Management for these soils is suggested under the heading "Range Management."

The following pages describe each capability unit and give suggestions for the use and management of the soils. The units are not numbered consecutively because not all units in the statewide system are represented in the Heber Valley Area. The capability classification for each soil is given in the "Guide to Mapping Units" at the back of this publication.

CAPABILITY UNIT IIIe-3 IRRIGATED

This unit consists of deep, well-drained soils that formed in mixed alluvium on alluvial fans and stream terraces. The surface layer is loam, silt loam, or coarse sandy loam. The subsoil is coarse sandy loam, loam, gravelly clay loam, clay or gravelly clay. Slopes are 2 to 15 percent.

The average annual precipitation is 16 to 20 inches, and the frost-free period is 70 to 90 days. Permeability is moderate to slow. Runoff is slow to medium, and the erosion hazard is slight to high. The soils hold 6 to 11 inches of available water to a depth of 5 feet. Roots easily penetrate to a depth of 4 to 5 feet or more.

The soils are used for alfalfa, small grain, and pasture.

Applying the right amount of irrigation water at the proper time so that it is evenly distributed over the entire field without causing erosion is the principal management need. Land leveling provides an even distribution if water is applied through controlled flooding. For best efficiency irrigation runs should be about 125 to 175 feet. Sprinkler irrigation is well suited to these soils. A cropping system of alfalfa or alfalfa-grass mixture for 6 to 8 years and 2 years of barley is well suited and also helps control erosion.

Commercial fertilizers are usually needed in addition to manure and plant residue to maintain good production. Small grain and grasses respond to applications of nitrogen. Alfalfa responds to applications of phosphorus.

CAPABILITY UNIT IIIw-3 IRRIGATED

This unit consists of deep, somewhat poorly and poorly drained soils that formed in mixed alluvium on stream terraces and flood plains. The surface layer is loam or silty clay. The next layer is loam, silt loam, clay loam, or clay that is gravelly in places. Below this is sandy loam, loam, or sandy clay loam that in places is gravelly, very gravelly, or very cobbly. Slopes are 0 to 5 percent.

The average annual precipitation is 16 to 20 inches, and the frost-free period is 70 to 90 days. Permeability is moderate to moderately slow above the water table. Runoff is slow, and the erosion hazard is slight. The soils hold 5 to 9 inches of available water to a depth of 5 feet. The water table fluctuates, but is usually about 20 to 40 inches below the surface. Roots easily penetrate to a depth of 5 feet or more unless restricted by the water table.

The soils are used for alfalfa, small grain, pasture, meadow hay, and meadow pasture.

Keeping the water table at a proper level below the root zone and providing enough irrigation water for optimum plant growth are the principal management needs. Draining the soils to lower the water table and land leveling to facilitate an even application of water are essential in some areas. Special studies are generally needed to determine the placement of drains and the irrigation method best suited.

A cropping system of alfalfa or alfalfa-grass mixture for 5 to 8 years and 2 years of barley is well suited to these soils if they are adequately drained. Undrained areas are used mainly for meadow hay and pasture.

Commercial fertilizers are generally needed in addition to manure and crop residue to maintain good production. Alfalfa responds to applications of phosphorus. Grasses and small grain respond to applications of nitrogen.

CAPABILITY UNIT IIIc-3 IRRIGATED

This unit consists of deep, well-drained soils that formed in mixed alluvium on alluvial fans and stream terraces. The surface layer is loam, silt loam, or gravelly loam. The subsoil is loam, gravelly loam, gravelly clay loam, or cobbly clay. The substratum ranges from loam to very cobbly clay or very gravelly loamy sand. Slopes are 1 to 3 percent.

The average annual precipitation is 16 to 20 inches, and the frost-free period is 70 to 90 days. Permeability is moderate to slow. Runoff is slow, and the erosion hazard is slight. The soils hold 6 to 11 inches of available water to a depth of 5 feet. Roots easily penetrate to a depth of 4 to 5 feet or more.

The soils are used for alfalfa hay, small grain, and irrigated pasture.

Applying the right amount of irrigation water to provide an even distribution without causing erosion is the main management need. Land leveling is generally needed. Border irrigation and controlled flooding are commonly used. Both are well suited to these soils. Sprinklers are also well suited.

A suitable crop rotation is 6 to 8 years of alfalfa and alfalfa-grass mixture and 2 years of barley.

Barley and grasses generally respond to applications of nitrogen fertilizer. Alfalfa responds to applications of phosphorus.

CAPABILITY UNIT IVe-3 IRRIGATED

This unit consists of deep, well-drained soils that formed in mixed alluvium on alluvial fans. The surface layer is silt loam. The subsoil is cobbly clay or silty clay. The substratum is silty clay or very cobbly clay loam. Slopes are 10 to 25 percent.

The average annual precipitation is 18 to 25 inches, and the frost-free period is 70 to 90 days. Permeability is slow. Runoff is medium to rapid, and the erosion hazard is slight to high. The soils hold 7 to 11 inches of available water to a depth of 5 feet. Roots easily penetrate to a depth of 5 feet or more.

The soils in this unit are used for alfalfa, small grain, and pasture.

Applying irrigation water uniformly in the proper amount without causing erosion is the principal management need. Sprinklers are well suited. Controlled flooding from gradient ditches is also suited, but careful control is needed to keep erosion at a minimum.

A suitable crop rotation is 6 to 8 years of alfalfa-grass mixture and 1 or 2 years of small grain. Alfalfa generally responds to applications of phosphorus, and grasses and small grain respond to nitrogen.

CAPABILITY UNIT IVe-33 IRRIGATED

This unit consists of shallow to moderately deep, well-drained to poorly drained soils that formed in mixed alluvium or in residuum over travertine on benches and stream terraces. The poorly drained soil has a moderately deep water table at a depth of 20 to 36 inches. The surface layer is silt loam. The underlying layer is loam or silty clay loam that is underlain at a depth of 6 to 30 inches by a lime-cemented hardpan or by travertine bedrock. Slopes are 0 to 5 slopes.

The average annual precipitation is 16 to 19 inches, and the frost-free period is 70 to 90 days. Permeability is moderate above the hardpan or the travertine. Runoff is slow, and the erosion hazard is slight to moderate. These soils hold 2 to 4 inches of available water to a depth of 5 feet. Roots can penetrate to a depth of less than 30 inches.

The soils in this unit are used for pasture, small grain, and gardens.

Applying irrigation water uniformly in the proper amount without causing excess erosion is the principal management need. Land leveling is limited or prohibited because of the shallow soils. The poorly drained soils require drainage to lower the water table. Drainage is difficult and costly, however, and special investigation is needed to determine the depth and spacing of drains. Sprinklers and controlled flooding methods are well suited.

A suitable cropping system is 6 to 8 years of alfalfa or alfalfa-grass and 2 years of barley. Commercial fertilizers are needed in addition to manure and crop residues to maintain good production. Alfalfa responds to applications of phosphorus, and small grain and pasture respond to nitrogen.

CAPABILITY UNIT IVe-34 IRRIGATED

This unit consists of deep, well-drained soils that formed in mixed alluvium and colluvium on alluvial fans, terminal moraines, and mountainsides. The surface layer is cobbly loam or gravelly fine sandy loam. The subsoil is loam, cobbly or very cobbly loam, clay, or cobbly fine sandy loam. The substratum is loam, clay loam, very cobbly loam, or very cobbly sandy clay loam. Slopes are 5 to 25 percent.

The average annual precipitation is 18 to 25 inches, and the frost-free period is 70 to 90 days. Permeability is moderate to slow. Runoff is slow to medium, and the erosion hazard is slight to high. These soils hold 3 to 10 inches of available water to a depth of 5 feet. Roots penetrate easily to a depth of 5 feet or more.

The soils are used mainly for pasture.

Applying irrigation water uniformly in the proper amount without causing excess erosion is the principal management need. Sprinklers are well suited. Controlled flooding from gradient ditches is also suited, but careful control is needed to keep erosion at a minimum. These cobbly and gravelly soils are difficult to till.

A suitable cropping system is alfalfa-grass for 6 to 8 years and small grain for 1 or 2 years. Grass pasture is a good use for these soils. Alfalfa responds to applications of phosphorus fertilizer, and grasses and barley respond to nitrogen.

CAPABILITY UNIT IVw-34 IRRIGATED

This unit consists of deep, poorly drained soils that formed in mixed alluvium on stream and river terraces. The surface layer is loam. The next layer is loam or very fine sandy loam. The substratum is very cobbly loamy coarse sand that has gravel-size fragments. Slopes are 0 to 3 percent.

The average annual precipitation is 16 to 20 inches, and the frost-free period is 70 to 90 days. Permeability is moderate. Runoff is slow, and the erosion hazard is slight. These soils hold 4 to 5 inches of available water to a depth of 5 feet.

The soils in this unit are used for pasture and meadow hay.

The principal management needs are keeping the water table at proper level below the root zone and proper irrigation to provide water for optimum plant growth. Drainage to lower the water table and land leveling to facilitate good water application may both be needed. Special studies are generally necessary to determine the placement of drains and the best suited irrigation method.

A cropping system of 5 to 8 years of alfalfa or alfalfa-grass mixture and 2 years of barley is well suited if the soils are properly drained. The undrained areas are mainly used for meadow hay or pasture. Commercial fertilizers are generally needed in addition to manure and crop residues to maintain good production. Alfalfa responds to applications of phosphorus, and grasses and small grain respond to nitrogen.

CAPABILITY UNIT IVw-35 IRRIGATED

This unit consists of deep, poorly drained soils that formed in mixed alluvium on stream terraces, flood plains, and alluvial fans. The surface layer is clay loam. The upper part of the substratum is clay loam and silty clay. The lower part is loam, clay loam, or clay that has some gravel in places. Slopes are 1 to 10 percent.

The average annual precipitation is 16 to 20 inches, and the frost-free period is 70 to 90 days. Permeability is very slow. Runoff is very slow to medium, and the erosion hazard is slight to moderate. These soils hold 10 to 11 inches of available water to a depth of 5 feet.

The soils in this unit are used for pasture, meadow hay, and some small grain.

The principal management needs are keeping the water table at a proper level below the root zone and proper irrigation to provide water for optimum plant growth. Drainage to lower the water table and land leveling to facilitate good water application may both be needed. Special studies are generally necessary to determine the placement of drains and the best suited irrigation method. Drainage is difficult and very costly on these very slowly permeable soils.

A cropping system of 5 to 8 years of alfalfa or alfalfa-grass mixture and 2 years of barley is well suited if these soils are properly drained. The undrained areas are mainly used for meadow hay or pasture. Commercial fertilizers are generally needed in addition to manure and crop residues to maintain good production. Alfalfa responds to applications of phosphorus, and grasses and small grain respond to nitrogen.

CAPABILITY UNIT IVs-34 IRRIGATED

This capability unit consists of deep, well-drained soils that formed in mixed alluvium on alluvial fans, stream terraces, and flood plains. The surface layer is loam, gravelly loam, cobbly loam or cobbly sandy loam. The subsoil and substratum are very gravelly loam, very gravelly coarse sandy loam, or loamy coarse sand. Commonly they are cobbly. Slopes are 1 to 3 percent.

The average annual precipitation is 16 to 18 inches; the frost-free period is 70 to 90 days. Permeability is rapid. Runoff is slow, and the erosion hazard is slight. These soils hold 2 to 4 inches of available water to a depth of 5 feet. Roots can penetrate to a depth of 4 to 5 feet or more.

The soils in this unit are used for pasture, alfalfa, (fig. 7), and small grain.

Applying irrigation water uniformly in the proper amount without causing excess erosion is the principal management need. Sprinklers are well suited to

Figure 7.—First cutting of well-managed alfalfa-bromegrass hay on Holmes gravelly sandy loam.

these droughty soils. Controlled flooding from gradient ditches is also suited, but careful control of water is needed to keep erosion at a minimum. These soils require frequent irrigation because the available water capacity is low. The cobbly and gravelly soils are difficult to till.

A suitable cropping system is alfalfa-grass for 6 to 8 years and small grain for 1 or 2 years. Grass pasture is a good use for these soils. Alfalfa responds to applications of phosphorus fertilizer, and grasses and barley respond to nitrogen.

CAPABILITY UNIT Vw-43 IRRIGATED

This unit consists of a shallow to moderately deep, poorly drained soil that formed in mixed alluvium on benches and stream terraces. This soil is silty clay loam throughout. Slopes are 0 to 3 percent.

The average annual precipitation is 16 to 19 inches, and the frost-free period is 70 to 90 days. Permeability is moderate above the travertine or lime-cemented hardpan. Runoff is slow, and the erosion hazard is slight. This soil holds 2 to 4 inches of available water above the travertine or lime-cemented hardpan. Roots can penetrate to a depth of 1 to 2.5 feet.

This soil is used for pasture and meadow hay.

CAPABILITY UNIT VIw-4 IRRIGATED

This unit consists of deep soils that have a fluctuating water table and may be flooded during periods of high runoff. These soils formed in mixed alluvium adjacent to streams. The surface layer is loam or sandy loam that is gravelly or cobbly in many places. It is underlain by gravelly or cobbly sand that in places is stratified with sandy loam and loam. Slopes are mainly 1 to 6 percent but range to 10 percent.

The average annual precipitation is 16 to 25 inches, and the frost-free period is 50 to 90 days. Permeability ranges from rapid to moderate depending on the stratification of materials. Runoff is slow to medium, and the erosion hazard is slight except for streambank cutting in places.

The soils in this unit are used mainly for meadow hay and pasture.

CAPABILITY UNIT VIe-H NONIRRIGATED

This unit consists of deep, well-drained soils that formed in colluvium, alluvium, residuum, and glacial drift on mountainsides, plateaus, and glacial moraines. The surface layer is loam, cobbly loam, gravelly loam, or clay loam. The subsoil is cobbly or gravelly loam, sandy clay loam, clay loam, or clay. The substratum is cobbly or gravelly sandy loam, loam, or clay. Slopes are 3 to 40 percent.

The average annual precipitation is 25 to 35 inches, largely snow. The frost-free period is about 50 days. Permeability is moderate to slow. Runoff is slow to rapid, and the erosion hazard is slight to moderate. These soils hold 5 to 8 inches of available water to a depth of 5 feet. They have a water-supplying capacity of 15 to 21 inches before the soil moisture is depleted. Roots can penetrate to a depth of 4 to 5 feet or more.

The soils in this unit are used for range, grazable woodland, watershed, wildlife, recreation, and summer homes. Some have an aspen cover.

CAPABILITY UNIT VIe-HC NONIRRIGATED

This unit consists of deep, well-drained soils that formed in residuum, colluvium, and glacial drift on mountainsides, plateaus, and glacial moraines. The surface layer is loam or coarse sandy loam and is cobbly in places. The subsurface layer is very cobbly loam, cobbly loam, or cobbly sandy loam. The subsoil is cobbly fine sandy loam or very cobbly clay. Slopes are 6 to 40 percent.

The average annual precipitation is 25 to 35 inches, largely snow. The frost-free period is about 50 days. Permeability is moderate to slow. Runoff is slow to medium, and the erosion hazard is slight to moderate. These soils hold 4 to 5 inches of available water to a depth of 5 feet. They have a water-supplying capacity of 10 to 16 inches before the soil moisture is depleted. Roots can penetrate to a depth of 3.5 to 5 feet or more.

The soils in this unit are used for woodland, watershed, wildlife, and recreation.

CAPABILITY UNIT VIe-M NONIRRIGATED

This unit consists of deep, well-drained soils that formed in colluvium, alluvium, glacial drift, and residuum on mountainsides, alluvial fans, and glacial moraines. The surface layer is loam, cobbly loam, silt loam, cobbly silt loam, gravelly loam, or gravelly fine sandy loam. The subsoil is loam, gravelly loam, cobbly sandy clay loam, clay, or cobbly clay. The substratum is very cobbly sandy loam, clay loam, gravelly or cobbly loam, and cobbly or very cobbly clay loam. Slopes are 3 to 40 percent.

The average annual precipitation is 18 to 25 inches, largely snow. The frost-free period is 50 to 70 days. Permeability is moderate to slow. Runoff is slow to rapid, and the erosion hazard is slight to high. These soils hold 4 to 11 inches of available water to a depth of 5 feet. They have a water-supplying capacity of 8 to 18 inches before the soil moisture is depleted. Roots can penetrate to a depth of 3.5 to 5 feet or more.

The soils in this unit are used for range, wildlife, watershed, and recreation.

CAPABILITY UNIT VIe-U NONIRRIGATED

This unit consists of deep, well-drained soils that formed in alluvium and residuum on alluvial fans and low mountainsides. The surface layer is loam, silt loam, or cobbly loam. The subsoil is loam, cobbly clay loam, or gravelly clay. The substratum is loam or cobbly clay loam. Slopes are 5 to 25 percent.

The average annual precipitation is 16 to 18 inches, largely snow. The frost-free period is 70 to 90 days. Permeability is slow to moderate. These soils hold 7 to 10 inches of available water to a depth of 5 feet. They have a water-supplying capacity of 10 to 14 inches before the soil moisture is depleted. Roots can penetrate to a depth of 4 to 5 feet or more.

The soils in this unit are used for range, wildlife, watershed, and recreation.

CAPABILITY UNIT VIe-H NONIRRIGATED

This unit consists of deep, somewhat excessively drained soils that formed in colluvium on mountainsides. The surface layer is loam or gravelly loam. The upper part of the substratum is very gravelly loamy

fine sand. The lower part is very gravelly sand that is up to 90 percent gravel and angular cobbles. Slopes are 25 to 40 percent.

The average annual precipitation is 25 to 35 inches, largely snow. The frost-free period is about 50 days. Permeability is rapid. Runoff is medium, and the erosion hazard is moderate. These soils hold 4 to 5 inches of available water to a depth of 5 feet. They have a water-supplying capacity of 12 to 14 inches before soil moisture is depleted. Roots can penetrate to a depth of 4 to 5 feet or more.

The soils in this unit are used for grazable woodland, watershed, wildlife, and recreation.

CAPABILITY UNIT VIIe–H NONIRRIGATED

This unit consists of deep, well-drained soils that formed in colluvium, residuum, and glacial drift on mountainsides and glacial moraines. The surface layer is loam, cobbly loam, or gravelly loam. The subsurface layer is very gravelly loam, very cobbly sandy loam, cobbly sandy clay loam, or cobbly loam. The subsoil is very gravelly loam, cobbly loam, cobbly clay loam, or cobbly clay. The substratum is very gravelly loam, very gravelly sandy loam, cobbly and very cobbly sandy loam, or cobbly clay. Slopes are 25 to 60 percent.

The average annual precipitation is 25 to 35 inches, much of it falling as snow. The frost-free period is about 50 days. Permeability is slow to moderate. Runoff is rapid, and the erosion hazard is high. These soils hold 5 to 8 inches of available water to a depth of 5 feet. The water-supplying capacity is 15 to 21 inches before the soil moisture is depleted. Roots can penetrate to a depth of 4 to 5 feet or more.

The soils in this unit are used for range, grazable woodland, watershed, wildlife, and recreation.

CAPABILITY UNIT VIIe–HC NONIRRIGATED

This unit consists of deep, well-drained and somewhat excessively drained soils that formed in colluvium and residuum on mountainsides. The surface layer is loam, gravelly loam, or cobbly loam. The subsurface layer is gravelly loam or very cobbly loam. The subsoil is very gravelly sandy clay loam or very cobbly clay. Slopes are 40 to 65 percent.

The average annual precipitation is 25 to 35 inches, largely snow. The frost-free period is about 50 days. Permeability is slow to moderate. Runoff is rapid, and the erosion hazard is high. These soils hold 4 to 5 inches of available water to a depth of 5 feet. They have a water-supplying capacity of 10 to 13 inches before soil moisture is depleted. Roots can penetrate to a depth of 3.5 to 5 feet or more.

The soils in this unit are used for woodland, watershed, wildlife, and recreation.

CAPABILITY UNIT VIIe–M NONIRRIGATED

This unit consists of deep, well-drained soils that formed in colluvium, residuum, and glacial drift on mountainsides and glacial moraines. The surface layer is loam, gravelly or cobbly loam, silt loam, cobbly silt loam, gravelly fine sandy loam, or cobbly fine sandy loam. The subsoil is loam, gravelly loam, clay, cobbly clay, or very cobbly sandy clay loam. The substratum is gravelly or cobbly loam, cobbly or very cobbly clay loam, clay loam, or very cobbly sandy loam. Slopes are 40 to 65 percent.

The average annual precipitation is 18 to 25 inches, largely snow. The frost-free period is 50 to 70 days. Permeability is slow to moderate. Runoff is rapid, and the erosion hazard is high. These soils hold 4 to 11 inches of available water to a depth of 5 feet. They have a water-supplying capacity of 8 to 18 inches before the soil moisture is depleted. Roots can penetrate to a depth of 3.5 to 5 feet or more.

The soils in this unit are used for range, wildlife, watershed, and recreation.

CAPABILITY UNIT VIIs–H NONIRRIGATED

This unit consists of deep, well-drained and somewhat excessively drained soils that formed in colluvium and glacial drift on mountainsides and glacial moraines. The surface layer is loam, gravelly loam, cobbly loam, or very cobbly loam. The subsoil is very gravelly loamy fine sand, very gravelly sandy loam, or cobbly sandy clay loam. The substratum is cobbly, very cobbly, or very gravelly sandy loam to loamy sand. Slopes are mostly 40 to 70 percent, but in small areas they are 6 to 40 percent.

The average annual precipitation is 25 to 35 inches, largely snow. The frost-free period is about 50 days. Permeability is moderate to rapid. Runoff is medium to rapid, and the erosion hazard is moderate to high. These soils hold 4 to 5 inches of available water to a depth of 5 feet. They have a water-supplying capacity of 12 to 14 inches before the soil moisture is depleted. Roots can penetrate to a depth of 4 to 5 feet or more.

The soils in this unit are used for grazable woodland, watershed, wildlife, and recreation.

CAPABILITY UNIT VIIs–M NONIRRIGATED

This unit consists of shallow to deep, well-drained soils that formed in residuum, alluvium, colluvium, and glacial drift on alluvial fans, glacial moraines, and mountainsides. The surface layer is very cobbly in textures of loamy sand, sandy loam, or sandy clay loam. The underlying material is very cobbly in textures of sandy loam, sandy clay loam, or clay. Slopes range from 6 to 70 percent but are mostly more than 25 percent.

The average annual precipitation is 18 to 25 inches, largely snow. The frost-free period is 50 to 70 days. Permeability is slow to rapid. Runoff is rapid or very rapid, and the erosion hazard is moderate to high. The shallow soils have a water-supplying capacity of 1.5 to 6 inches before soil moisture is depleted. The deep soils have a water supplying capacity of 6 to 15 inches. Root penetration is limited to a depth of about 20 inches in the shallow soils and 5 feet or more in the deep soils.

The soils in this unit are used for range, watershed, and wildlife.

CAPABILITY UNIT VIIs–U NONIRRIGATED

This unit consists of deep, well-drained soils that formed in alluvium and colluvium on low mountainsides and stream terraces. The surface layer is gravelly or cobbly loam, very cobbly loam, or very cobbly sandy loam. The subsoil is very cobbly sandy clay loam or very gravelly loam. The substratum is very cobbly sandy clay loam, very gravelly sandy loam, or

very gravelly loamy sand. Slopes are 1 to 45 percent.

The average annual precipitation is 16 to 18 inches. The frost-free period is 70 to 90 days. Permeability is rapid to moderately slow. Runoff is medium to slow, and the erosion hazard is slight to moderate. These soils hold 3 to 4 inches of available water to a depth of 5 feet. The water-supplying capacity is 6 to 8 inches before the soil moisture is depleted. Roots can penetrate to a depth of 4 to 5 feet or more.

The soils in this unit are used for range, wildlife, recreation, and homesites.

CAPABILITY UNIT VIIIs-X NONIRRIGATED

This unit consists of two miscellaneous land types. They have a thin soil mantle, generally less than 4 inches thick overlying the bedrock. There is little vegetation because the soil material is very shallow. The unit is used for wildlife and recreation.

Range Management[2]

Nearly 90 percent, or 277,000 acres, of Heber Valley Area is range. Stoniness, rockiness, steep slopes, and climate make the foothills, plateaus, and mountains surrounding Heber and Wallsburg Valleys unsuitable for cultivation. The use of these areas, however, for livestock grazing, wildlife, recreation, and watershed contributes largely to the economy of the area and is a valuable asset to surrounding areas and communities. The productive soils and high annual rainfall, from 16 to 35 inches, make possible the production of a high yield of forage for livestock and big-game animals. Past misuse of some of the range has reduced the usable forage production to less than one-half its potential. This is especially pronounced in the foothills where oakbrush and sagebrush have replaced much of the better grasses, browse, and forbs.

Sheep and cattle graze the lower mountains and foothills during May and June and again in October. The high mountains are grazed during July, August, and September. Sheep grazing is the dominant livestock use in the survey area, but cattle grazing is the primary use on a few ranches. There is little common grazing (same range used by cattle and sheep) by livestock in the survey area.

Range sites and range condition

There are many differences in the soils and climate of Heber Valley. For these reasons, there are several different kinds of range. These different kinds of range are called range sites.

Over the centuries, a mixture of plants best adapted for growing on each range site has developed. This group of plants is called the potential, or climax, plant community for the site.

Range conservationists and soil scientists, working together, group soils which naturally grow the same climax plant communities into range sites.

Repeated overuse by grazing animals, excessive burning, or plowing result in changes in the kinds, proportions, or amounts of climax plants in the plant community. Depending on the kind and degree of disturbance, some kinds of plants increase while others decrease. If the disturbance is severe, plants that do not belong in the climax plant community may invade. Plant response to grazing use depends on the kind of grazing animal, the season of use, and how closely the plant is grazed. If good management follows disturbances, however, the climax plant community is gradually reestablished unless the soil resource has been seriously altered.

Range condition is an expression of how the present plant community compares with the climax plant community for the range site. Four range conditions are recognized. The range is in *excellent* condition if 76 to 100 percent of the forage is potential, or climax, vegetation for the site. It is in *good* condition if 51 to 75 percent is potential vegetation. It is in *fair* condition if 26 to 50 percent is potential vegetation, and in *poor* condition if less than 25 percent is potential vegetation.

The present range condition provides an index to changes which have taken place in the plant community. More important, however, range condition is a basis for predicting the kinds and amounts of changes in the present plant community that can be expected from management and treatment measures. Thus, the range condition rating indicates the nature of the present plant community, and the climax cover for the range sites represents a goal toward which range management may be directed.

Knowledge of the climax plant communities of range sites and the nature of present plant communities in relation to that potential is important in planning and applying conservation measures. Such information is the basis for selecting management objectives, designing grazing systems, managing for wildlife and recreation areas, and for rating watershed conditions.

Any management of range must provide for a plant cover which will adequately protect or improve the soil and water resources and meet the needs of the operator. This generally involves increasing desirable plants and restoring the plant community to near climax condition. Sometimes, however, a plant cover that is somewhat below climax will better fit specific grazing needs, provide better wildlife habitat, or furnish other benefits while still protecting the soil and water resource.

Proper grazing use.—Experience in the survey area has shown that generally when not more than half of the current season's growth of key forage plants is grazed, the better plants are able to maintain their growth and vigor. Where slopes are 40 percent or less, the range plants need about 50 percent or more of each year's growth of leaves to maintain themselves and produce maximum amounts of forage. Where slopes are more than 40 percent, the proportion of top growth left should be increased 15 percent for each 10-percent increase in slope to control erosion and maintain the vegetative cover. Areas where slopes are more than 70 percent are too steep to be grazed.

Livestock should not be turned onto the range in the spring until the soil is dry and firm enough underfoot that the forage plants will not be damaged and the soil will not be puddled by trampling. The new growth of grasses should be 4 to 7 inches high,

[2] By DEWITT C. GRANDY and LAMAR R. MASON.

depending on the species, before livestock are allowed to graze, if best results are to be obtained.

Rotation-deferred grazing.—Sound range management requires that the intensity of grazing use be adjusted according to the forage production from one season to another. The efficiency of range use can be increased as much as 30 percent if a system of rotation-deferred grazing is followed on most of the range sites in the survey area. Under this plan of range management, the livestock graze on several different parts of the range for short periods. Generally, under this system, no area is grazed more than half of any growing period nor at the corresponding time in successive years. Not more than 50 percent of the growth should be grazed in any year for most rapid improvement or maintenance of the range.

A range that is closely grazed early in spring should be deferred at least the last half of the growing season in order to recover. A late season recovery period permits seedlings and young plants to survive and develop.

Range seeding.—Moisture does not limit seeding in the survey area. Some sites, however, are so steep, stony, or covered with trees that seeding is limited to broadcasting. This may result in a poor stand if the seed does not get covered.

Range seeding is a method of rapidly increasing the forage resources. A good seeding can increase the forage yield several times.

Seeding is especially useful where the vegetation is so depleted that it cannot recover within a reasonable time through management only. Suitable species of native or introduced grasses and legumes are used.

Species should be suited to the climate and soil of the Area. The species should be limited to one grass and one legume in this Area. If brush is a problem, it must be eliminated. A seedbed may be prepared by plowing in June. Summer rains ordinarily film the seedbed enough that seed can be drilled in fall.

Where a seedbed has been prepared, seed should be drilled between September 1 and the first snowfall. Recently burned areas generally require no seedbed preparation. Seed can be drilled successfully into the firm soil. In aspen areas where a seedbed is not prepared, the seed should be broadcast prior to leaf fall and preferably in front of a sheep herd. The sheep help trample the seed into the soil, and the aspen leaves also help cover it.

Seeding is most effective when a favorable season of precipitation follows to help establish the stand. The range should be protected from grazing long enough after seeding for the establishment and maintenance of the stand.

Some soils in the Area can be seeded by drilling. Some are difficult to seed by drilling because they are cobbly and stony. Others can be seeded only by broadcasting. All are identified by range site and map symbol in the following listing.

Soils easily seeded by drilling—
- HIGH MOUNTAIN LOAM SITE
  - Buell: BVC, BVD
  - Clayburn: CBB, CBC, CBD, CCD
  - Sessions: SEC, SED
- MOUNTAIN LOAM SITE
  - Broadhead: BPC, BTC, HWC (Broadhead soil only), BPD, BTD
  - Cloud Rim: CMD
  - Henefer: HJC, YTC (Henefer soil only), HJD, YTD (Henefer soil)
  - Rasband: RCC
  - Whipstock: WSC, WSD
- MOUNTAIN GRAVELLY LOAM (OAKBRUSH) SITE
  - Gappmayer: GAD
- UPLAND LOAM SITE
  - Clegg; CgC, WLC (Clegg soil), WLD (Clegg soil)
  - Deer Creek: DWC, WNC (Deer Creek soil only), DWD, WND (Deer Creek soil)
  - Watkins Ridge: DWC, WLC, WNC, DWD, WLD, WND
- SEMI-WET MEADOW SITE
  - Cudahy: Cv
- WET STREAM BOTTOM SITE
  - Fluventic Haploborolls: FA

Cobbly and stony soils difficult to seed by drilling—
- MOUNTAIN LOAM SITE
  - Broadhead; BPC, BTC, BPD, BTD
  - Henefer: HJC, HJD
  - Whipstock: WSC, WSD

Soils seeded by broadcasting—
- MOUNTAIN LOAM SITE
  - Cloud Rim: CNF
- HIGH MOUNTAIN LOAM (ASPEN) SITE
  - Baird Hollow: BAC, BAD, BAE, BAF, BCC, BCE, BDC
  - Clayburn: CCD
  - Flygare: FBB, FBC, FBD, FLD, FLE, FRE, FRF
  - Hailman: HAC, HAD, HBF
  - Mult: MRE, MSD
  - Roundy: RRC, RRD, RRE, RRF, RSC, RSD, RUF, RYD
- HIGH MOUNTAIN STONY LOAM (ASPEN) SITE
  - Daybell: DAF, DBE, DBF, COF (Daybell part)
  - Poleline: POF

Grazable woodland.—Range sites with an overstory of trees are extensive in this survey area. They consist of a high-producing range forage understory and an aspen and scattered conifer tree overstory. Management for conifers is not practical. Conifer species are well suited to Christmas trees and are used largely for this purpose.

Range sites with an aspen and conifer overstory produce green feed for livestock for a much longer period than adjacent sites that do not have trees. Excessive grazing will destroy the stand, and aspen cannot reclaim the lost area because reproduction by seed is unknown in the survey area. Old even-aged stands without a reproductive understory need to be managed with care to see that grazing does not prevent the growth of a new stand.

Brush speeds the improvement of some range sites. In the survey area brush management is limited mostly to big sagebrush and oakbrush. The cost of removing oakbrush to date has made this operation generally impractical. Big sagebrush can be successfully controlled by plowing or burning if the area is to be seeded. On the sites where good forage grasses are still abundant, the big sagebrush can be controlled by chemical sprays and burning. A period of grazing deferment is needed for the grasses to regain good vigor, which is necessary to rapid range improvement. Rotobeating and railing of big sagebrush are

limited and often not successful. Some areas are too steep, and some have too many stones and cobbles.

Soils suitable for big sagebrush control by chemical sprays, controlled burning, or plowing—

HIGH MOUNTAIN LOAM

Buell gravelly loam, 6 to 15 percent slopes: BVC

Buell gravelly loam, 15 to 25 percent slopes: BVD

Clayburn loam, 3 to 6 percent slopes: CBB

Clayburn loam, 6 to 15 percent slopes: CBC

Clayburn loam, 15 to 25 percent slopes: CBD, CCD

Clayburn soils, 25 to 40 percent slopes: CDE

Sessions clay loam, 5 to 15 percent slopes: SEC

Sessions clay loam, 15 to 25 percent slopes: SED

MOUNTAIN LOAM

Broadhead soils, 6 to 15 percent slopes: BPC, BTC, HWC

Broadhead soils, 15 to 25 percent slopes: BPD, BTD

Broadhead soils, 25 to 40 percent slopes: BPE, BTE, HWE

Cloud Rim loam, 10 to 25 percent slopes: CMD

Cloud Rim loam, 25 to 40 percent slopes: CME

Henefer soils, 6 to 10 percent slopes: HJC, YTC

Henefer soils, 10 to 25 percent slopes: HJD, YTD

Rasband coarse sandy loam, 3 to 6 percent slopes: RaB

Whipstock soils, 6 to 15 percent slopes: WSC

Whipstock soils, 15 to 25 percent slopes: WSD

Whipstock soils, 25 to 40 percent slopes: WSE

MOUNTAIN GRAVELLY LOAM (OAKBRUSH)

Gappmayer gravelly fine sandy loam, 15 to 25 percent slopes: GAD

UPLAND LOAM

Clegg loam, 6 to 15 percent slopes: CgC, WLC

Clegg loam, 15 to 25 percent slopes: WLD

Deer Creek loam, 6 to 15 percent slopes: DWC, WNC

Deer Creek loam, 15 to 25 percent slopes: DWD, WND

Watkins Ridge silt loam, 6 to 15 percent slopes: DWC, WLC, WNC

Watkins Ridge silt loam, 15 to 25 percent slopes: DWD, WLD, WND

Descriptions of range sites

The range sites of Heber Valley Area are described on the following pages, and the climax plants are listed for each site. Plants most likely to invade are also mentioned. In addition, an estimate of the potential annual production of air-dry vegetation is indicated for each site. The soils in each range site can be determined by referring to the "Guide to Mapping Units" at the back of this soil survey.

The range sites in the survey area are in one of three climatic zones: High Mountain, Mountain, or Upland.

High Mountain Climatic Zone (25 to 35 inches precipitation)

The high mountain climatic zone is characterized by cold temperatures and heavy snow cover in winter and moist, cool summers. The average annual precipitation is 25 to 35 inches. Distribution is 4 to 8 inches during the plant growing period and 15 to 27 inches during the nongrowing period. May through August are the driest months of the year. Plant growth begins about May 15 and ends near September 5, when killing frost occurs. The frost-free period is about 65 days, from June 20 to August 25. The mean annual air temperature is about 40° F.

The three range sites in this zone are described in the paragraphs that follow.

HIGH MOUNTAIN LOAM RANGE SITE

The soils in this range site are deep and well drained. They have a surface layer of very dark brown loam, clay loam, or gravelly loam. The subsoil is dominantly clay loam and clay, but in places is very gravelly loam. Parent materials are derived from andesites and mixed sedimentary and quartzite rocks. These sloping to very steep soils are on mountainsides, plateaus, and glacial moraines. The slope range is 3 to 40 percent. The elevation is 7,500 to 9,300 feet.

Permeability is moderate to slow. The erosion hazard is slight to moderate. The water-holding capacity is 4 to 9 inches to a depth of 5 feet. The water-supplying capacity is 8 to 18 inches. Roots extend to a depth of 5 feet or more.

The potential, or climax, plant community on this site, by weight, is 20 percent slender wheatgrass, 15 percent mountain brome, 5 percent bearded wheatgrass, and 5 percent other grasses; 5 percent peavine, 3 percent or less each of larkspur, sweet anise, and edible valerian, and 14 percent other forbs; 7 percent snowberry, 5 percent Gambel oak, 1 percent elderberry, and 17 percent other shrubs.

This site produces about 4,000 pounds per acre of air-dry forage in favorable years and 1,450 pounds in unfavorable years. About 70 percent of this production is from plants that furnish forage for livestock and big-game animals.

Under continuous heavy grazing bearded wheatgrass, slender wheatgrass, mountain brome, edible valerian, and sweet anise decrease. Such plants as Kentucky bluegrass, Letterman needlegrass, prairie junegrass, tall native bluegrass, several forbs, big sagebrush, Gambel oak, silver sagebrush, and snowberry increase. Invaders are annual forbs and grasses.

HIGH MOUNTAIN LOAM (ASPEN) RANGE SITE

The soils of this range site are deep and well drained and free of lime. They have a surface layer of very dark brown loam or clay loam 15 to 30 inches thick, which is cobbly in places. The subsoil is cobbly loam to cobbly clay. Parent materials are derived from andesite, mixed sedimentary, and quartz diorite

porphyry rocks. The slope range is 3 to 60 percent on all exposures. The elevation is 6,500 to 9,300 feet.

Permeability is slow to moderately rapid, and the erosion hazard is slight. The water-holding capacity is 6 to 8 inches to a depth of 5 feet. The water-supplying capacity is 13 to 19 inches. Roots can penetrate to a depth of 5 feet or more.

The potential, or climax, plant community on this site, by weight, is 5 percent blue wildrye, 5 percent bearded wheatgrass, 10 percent mountain brome, 2 percent nodding bluegrass, 3 percent slender wheatgrass, and 10 percent other grasses; 5 percent butterweed, 5 percent edible valerian, 5 percent peavine, and 5 percent other forbs; 40 percent quaking aspen (fig. 8), and 5 percent other shrubs.

This site produces about 5,300 pounds per acre of air-dry herbage in favorable years and 2,000 pounds per acre in unfavorable years. About 65 percent of this production is from plants that furnish forage for livestock and big-game animals.

Under continuous heavy grazing blue wildrye, bearded wheatgrass, mountain brome, nodding brome, slender wheatgrass, butterweed, edible valerian, sweet anise, and aspen decrease. Such plants as Columbia needlegrass, Kentucky bluegrass, elk sedge, several forbs, snowberry, elderberry, and aspen increase. Invaders are tarweed, knotweed, houndstongue, and muleseardock.

HIGH MOUNTAIN STONY LOAM (ASPEN) RANGE SITE

The soils in this range site are deep, well drained, and free of lime. They have a medium-textured, very dark brown surface layer. The subsoil and substratum are very gravelly or very cobbly loamy fine sand to clay loam. Parent materials are mixed sedimentary, andesite, and quartzite rocks. This site occurs dominantly on north and northeast mountainsides. The slope range is 6 to 70 percent. The elevation is 7,000 to 8,800 feet.

Permeability is moderate to moderately rapid. The erosion hazard is slight. The water-holding capacity is 4 to 6 inches to a depth of 5 feet. The water-supplying capacity is 10 to 16 inches. Roots extend to a depth of 5 feet or more.

Figure 8.—**Sheep grazing in an open park on the High Mountain Loam (Aspen) range site in the eastern part of the survey area. The aspen stand has been destroyed. The soil is Baird Hollow loam, 6 to 15 percent slopes.**

The potential, or climax, plant community on this site, by weight, is 5 percent bearded wheatgrass, 10 percent blue wildrye, 5 percent slender wheatgrass, and 5 percent other grasses; 2 percent peavine and 23 percent other forbs; 35 percent quaking aspen, 3 percent elderberry, 5 percent snowberry, and 7 percent other shrubs.

This site produces about 2,800 pounds per acre of air-dry herbage in favorable years and 1,300 pounds per acre in unfavorable years. About 65 percent of this production is from plants that furnish forage for livestock and big-game animals.

Under continuous heavy grazing bearded wheatgrass, blue wildrye, slender wheatgrass, butterweed, and aspen decrease. Such plants as Columbia needlegrass, dryland sedge, Kentucky bluegrass, Letterman needlegrass, several forbs, aspen, snowberry, gooseberry, and chokecherry increase. Invaders are big sagebrush, annual grasses and weeds, houndstongue, sneezeweed, and tarweed.

Mountain Climatic Zone (18 to 25 inches precipitation)

The mountain climatic zone is characterized by cold winters and fairly heavy snow cover. The annual precipitation is 18 to 25 inches, of which about 4.4 inches falls during the plant growing period and 18 inches during the nongrowing period. May through September are the driest months. Plant growth begins about May 1 and ends near September 1 due to lack of moisture. The frost-free period is about 77 days, from June 19 to September 4. The mean annual air temperature is about 42° to 44° F.

MOUNTAIN LOAM RANGE SITE

The soils in this range site are deep, well drained, permeable, and free of lime. They have a surface layer of very dark brown loam and sandy loam 8 to 12 inches thick. The subsoil is sandy loam to clay and is cobbly or stony in places. The amount of cobbles and stones commonly increases with increasing depth. Parent materials are derived from andesites and mixed sedimentary rocks. These gently sloping to very steep soils occur on alluvial fans, terminal moraines, and mountainsides on all exposures. The slope range is 3 to 65 percent. The elevation is 5,300 to 7,500 feet.

Permeability is moderate to slow, and the erosion hazard is slight to moderate. The water-holding capacity is 4 to 10 inches to a depth of 5 feet. The water-supplying capacity is 8 to 18 inches. Roots extend to a depth of 5 feet or more.

The potential, or climax, plant community on this site, by weight, is 66 percent bluebunch wheatgrass, 3 percent basin wildrye, 6 percent muttongrass, and 10 percent other grasses; 2 percent hawksbeard, 1 percent arrowleaf balsamroot, and 2 percent other forbs; 2 percent big sagebrush, 4 percent antelope bitterbrush, 1 percent rose, 1 percent yellowbrush, and 2 percent other shrubs.

This site produces about 2,500 pounds per acre of air-dry herbage in favorable years and 1,200 pounds per acre in unfavorable years. About 96 percent of this production is from plants that furnish forage for livestock and big-game animals.

Under continuous heavy grazing bluebunch wheatgrass, muttongrass, slender wheatgrass, blue wildrye, mountain brome, hawksbeard, birchleaf mahogany, bitterbrush, and rose decrease. Such plants as Letterman needlegrass, Kentucky bluegrass, squirreltail, western wheatgrass, big sagebrush, Gambel oak, yellowbrush, snowberry, and maple increase. Invaders in this site are rubber rabbitbrush, cheatgrass, snakeweed, houndstongue, gumweed, and mullein.

MOUNTAIN GRAVELLY LOAM (OAKBRUSH) RANGE SITE

The soils in this site are very cobbly or very gravelly, well drained, permeable, and lime free to slightly limy in the subsoil. The surface layer is very dark brown sandy loam or loam and is gravelly or very cobbly in places. The subsoil is very cobbly sandy loam to very cobbly sandy clay loam. Parent materials are derived from mixed sedimentary and quartz diorite porphyry rocks. These sloping to very steep soils occur on mountainsides and terminal moraines. The slope range is 5 to 65 percent. The elevation is 5,500 to 7,200 feet.

Permeability is moderately slow to moderately rapid, and the erosion hazard is slight to moderate. The water-holding capacity is 4 to 7 inches to a depth of 5 feet. The water-supplying capacity is 8 to 14 inches. Roots extend to a depth of 5 feet or more.

The potential, or climax, plant community on this site, by weight, is 10 percent bluebunch wheatgrass, 3 percent Kentucky bluegrass, 10 percent mountain brome, 10 percent muttongrass, and 12 percent other grasses; 2 percent arrowleaf balsamroot, 1 percent hawksbeard, 2 percent horsemint, and 5 percent other forbs; 5 percent birchleaf mountainmahogany, 5 percent antelope bitterbrush, 25 percent Gambel oak, and 10 percent other shrubs.

This site produces about 2,300 pounds per acre of air-dry herbage in favorable years and 1,500 pounds per acre in unfavorable years. About 60 percent of this production is from plants that furnish forage for livestock and big-game animals.

Under continuous heavy grazing bluebunch wheatgrass, bearded wheatgrass, slender wheatgrass, muttongrass, balsamroot, hawksbeard, birchleaf mountainmahogany, and bitterbrush decrease. Such plants as Letterman needlegrass, Kentucky bluegrass, squirreltail, several perennial forbs, Gambel oak, snowberry, and big sagebrush increase. Invaders are annual weeds, cheatgrass, rubber rabbitbrush, houndstongue, horsebrush, mullein, and gumweed.

MOUNTAIN STONY LOAM RANGE SITE

The soils of this range site are very cobbly or very gravelly, well drained, and permeable and are lime free to slightly limy in the subsoil. The surface layer is very dark brown, very cobbly loam. The subsoil is very cobbly loam to very cobbly heavy clay. Parent materials are derived from mixed sedimentary and andesite rocks. These moderately steep to very steep soils occur on mountainsides and alluvial fans on all exposures. The slope range is 6 to 60 percent. The elevation is 5,500 to 8,000 feet.

Permeability is slow to moderately rapid, and the erosion hazard is slight to moderate. The water-holding capacity is about 4 to 5 inches to a depth of 5

feet. The water-supplying capacity is 8 to 10 inches. Roots extend to a depth of 5 feet or more.

The potential, or climax, plant community on this site, by weight, is 50 percent bluebunch wheatgrass, 1 percent basin wildrye, 5 percent muttongrass, and 14 percent other grasses; 1 percent arrowleaf balsamroot and 9 percent other forbs; 3 percent big sagebrush, 5 percent birchleaf mountainmahogany, 5 percent antelope bitterbrush, 2 percent Gambel oak, and 5 percent other shrubs.

This site produces about 2,500 pounds per acre of air-dry herbage in favorable years and 700 pounds per acre in unfavorable years. About 82 percent of this production is from plants that furnish forage for livestock and big-game animals.

Under continuous heavy grazing bluebunch wheatgrass, slender wheatgrass, muttongrass, mountain bromegrass, bearded wheatgrass, hawksbeard, edible valerian, birchleaf mountainmahogany, bitterbrush, and rose decrease. Plants such as Letterman needlegrass, Kentucky bluegrass, needleandthread, squirreltail, several perennial forbs, Gambel oak, big sagebrush, yellowbrush, and snowberry increase. Invaders are annual weeds and grasses, houndstongue, mullein, snakeweed, and rubber rabbitbrush.

MOUNTAIN SHALLOW LOAM RANGE SITE

The soils in this site are shallow and lime free, and rock outcrops are numerous. The surface layer is very dark reddish-brown to very dark grayish-brown loamy sand to sandy clay loam, and it is very cobbly. The subsoil is clay loam to loamy sand and very cobbly. Parent materials are derived from quartz-diorite porphyry, andesites, and mixed sedimentary rocks. These gently sloping to very steep soils are on mountainsides. The slope range is 6 to 70 percent on all exposures. The elevation is 5,200 to 8,000 feet.

Permeability is rapid to moderate above the bedrock. The erosion hazard is moderate to high. The water-holding capacity is low, 1 to 3 inches. The water-supplying capacity is 3 to 8 inches. Root growth is restricted by the bedrock to a depth of about 18 inches except where fractured and cracked.

The potential, or climax, plant community on this site, by weight, is 30 percent bluebunch wheatgrass, 10 percent basin wildrye, 1 percent Indian ricegrass, 5 percent muttongrass, and 4 percent other grasses; 2 percent arrowleaf balsamroot, 1 percent tapertip hawksbeard, and 2 percent other forbs; 10 percent big sagebrush, 25 percent antelope bitterbrush, 5 percent birchleaf mountainmahogany, and 5 percent other shrubs.

This site produces about 1,700 pounds per acre of air-dry herbage in favorable years and 600 pounds per acre in unfavorable years. About 93 percent of this production is from plants that furnish forage for livestock and big-game animals.

Under continuous heavy grazing bluebunch wheatgrass, muttongrass, bearded wheatgrass, hawksbeard, bitterbrush, and birchleaf mountainmahogany decrease. Plants such as Letterman needlegrass, Kentucky bluegrass, mat muhly, basin wildrye, Indian ricegrass, several perennial forbs, big sagebrush, snowberry, Gambel oak, and horsebrush increase. Invaders are cheatgrass, annual weeds, houndstongue, snakeweed, juniper, pinon pine, rubber rabbitbrush, and mullein.

SEMI-WET MEADOWS RANGE SITE

The soils in this range site are moderately deep to shallow and poorly or somewhat poorly drained. The surface layer is thick black silt loam or clay loam. The subsoil is silty clay loam or silt loam that is underlain by a lime hardpan or travertine. Parent materials are mixed rocks. This site is in the valley area near Midway. The elevation is about 5,800 feet. The slope range is 0 to 3 percent.

The vegetation is mainly sedges, wiregrass, and associated plants used for pasture and meadow hay.

The potential, or climax, plant community on this site, by weight, is 10 percent basin wildrye, 25 percent slender wheatgrass, 5 percent sedges, 5 percent muttongrass, 5 percent western wheatgrass, 10 percent tufted hairgrass, and 30 percent other grasses; 2 percent edible valerian and 3 percent other forbs; and 5 percent shrubs and trees.

This site produces about 4,200 pounds per acre of air-dry herbage in favorable years and 1,750 pounds per acre in unfavorable years. About 92 percent of this production is from plants that furnish forage for livestock and big-game animals.

Under continuous heavy grazing slender wheatgrass, muttongrass, basin wildrye, tufted hairgrass, and edible valerian decrease. Plants such as Kentucky bluegrass, field horsetail, rushes, sedges, western wheatgrass, several forbs, water sagebrush, willow, and shrubby cinquefoil increase. Invaders are big sagebrush, rubber rabbitbrush, foxtail, gumweed, tarweed, burdock, and snakeweed.

Upland Climatic Zone (14 to 18 inches precipitation)

The Upland climatic zone is characterized by cold winters that have moderate snow cover. The annual precipitation is 14 to 18 inches. Distribution is 3.8 inches during the plant growing period and 12.5 inches during the nongrowing period. June and July are the driest months, and August and September are the next driest months. Plant growth begins about April 20 and ends August 15. Some regrowth may occur in the fall if sufficient moisture is available. The frost-free period is about 83 days, from June 14 to September 5. The mean annual air temperature is about 44° F.

UPLAND LOAM RANGE SITE

The soils in this site are deep, well drained, and permeable. The surface layer is very dark brown loam and silt loam 8 to 12 inches thick. The subsoil is loam to gravelly clay. The substratum may have a few cobbles imbedded in a marly lime horizon. Parent materials are derived from mixed sedimentary rocks and andesites. These moderately steep and hilly soils are on foothills on all exposures. The slope range is 5 to 25 percent. The elevation is 5,300 to 6,400 feet.

Permeability is moderate to slow. The erosion hazard is slight to moderate. The water-holding capacity is 7 to 10 inches to a depth of 5 feet. The water-supplying capacity is 9 to 14 inches. Roots extend to a depth of 5 feet or more.

The potential, or climax, plant community on this site, by weight, is 35 percent wheatgrass, 6 percent Indian ricegrass, 5 percent basin wildrye, 5 percent Sandberg bluegrass, and 9 percent other grasses; 4 percent arrowleaf balsamroot, 5 percent peavine, and 11 percent other forbs; 5 percent big sagebrush, 5 percent yellowbrush, and 10 percent other shrubs.

This site produces about 2,250 pounds of air-dry herbage per acre in favorable years and 700 pounds per acre in unfavorable years. About 80 percent of this production is from plants that furnish forage for livestock and big-game animals.

Under continuous heavy grazing bluebunch wheatgrass (fig. 9), muttongrass, bitterbrush, and hawksbeard decrease in the plant community. Such plants as Indian ricegrass, needleandthread, western wheatgrass, and big sagebrush increase. If excessive grazing use continues, annual weeds, cheatgrass, juniper, and snakeweed may invade the site. These invaders and big sagebrush may make up the total vegetation on range in the poorest condition.

UPLAND STONY LOAM RANGE SITE

The soils in this site are deep, well drained, and are limy in the subsoil. The surface layer is very dark grayish brown to very dark brown very cobbly loam 8 to 12 inches thick. The subsoil is light grayish brown very cobbly loam to clay loam. It is underlain by marly material below a depth of 24 inches. These nearly level to steep soils are on alluvial fans and foothills. The slope range is 1 to 45 percent. The elevation is 5,300 to 6,400 feet.

Permeability is moderate to moderately slow. The erosion hazard is slight to moderate. The water-holding capacity is 1 to 3 inches to a depth of 5 feet. The water-supplying capacity is 3 to 7 inches. Roots extend to a depth of 3 to 5 inches or more.

The potential, or climax, plant community on this site, by weight, is 56 percent bluebunch wheatgrass, 3 percent Indian ricegrass, 2 percent Nevada bluegrass, and 9 percent other grasses; 1 percent arrowleaf balsamroot, 1 percent phlox, and 3 percent other forbs; 5 percent big sagebrush, 2 percent birchleaf

Figure 9.—**A 3-year old crested wheatgrass seeding on an Upland Loam range site in an area accidentally burned. The soil is Watkins Ridge silt loam, 15 to 25 percent slopes.**

mountainmahogany, 3 percent antelope bitterbrush, 5 percent black sagebrush, and 10 percent other shrubs.

This site produces a total of 1,750 pounds per acre in favorable years and 600 pounds per acre in unfavorable years. About 93 percent of this production is from plants that furnish forage for livestock and big-game animals.

Under continuous heavy grazing bluebunch wheatgrass, Nevada bluegrass, balsamroot, hawksbeard, birchleaf mountainmahogany, and bitterbrush decrease. Such plants as Kentucky bluegrass, needleandthread, squirreltail, western wheatgrass, big sagebrush, shadscale, and horsebrush increase. With continued heavy use annual weeds, cheatgrass, mullein, juniper, pinyon pine, and snakeweed invade the site.

WET STREAM BOTTOMS RANGE SITE

Only Fluventic Haploborolls are in this range site. These soils are recent alluvial deposits that vary widely in texture. They range from gravelly to very cobbly loam material underlain by loose gravel at a depth of about 10 to 15 inches. The water-holding capacity is low, but the water table in most places is near the surface much of the time and keeps areas wet. The parent material is alluvium derived from a wide assortment of rocks.

This site occurs adjacent to the larger perennial streams in the valley bottoms and adjacent to the smaller side drainages. The water table fluctuates with streamflow. During periods of high runoff the lands may be flooded, resulting in both erosion and deposition. The slope range is 1 to 5 percent, and the topography is channeled. The elevation is 5,600 to 7,300 feet.

Plant production is influenced mostly by the high water table and very little by annual precipitation. Plant growth begins about April 20 and continues until the grasses and forbs mature, which is near September 1. Killing frosts limit browse and grass regrowth on about October 1.

The potential, or climax, plant community on this site, by weight, is 5 percent blue wildrye, 10 percent sedges, 5 percent slender wheatgrass, 15 percent tufted hairgrass, and 10 percent other grasses and grasslike plants; 2 percent cowcabbage, 5 percent peavine, and 8 percent other forbs; 5 percent thinleaf alder, 5 percent water birch, 5 percent narrowleaf cottonwood, 5 percent willow, and 20 percent other shrubs and trees.

This site produces about 3,500 pounds per acre of air-dry herbage in favorable years and 2,000 pounds per acre in unfavorable years. About 50 percent of this production is from plants that furnish forage for livestock and big-game animals.

Under continuous heavy grazing blue wildrye, slender wheatgrass, tufted hairgrass, tall native bluegrass, cowcabbage, and clovers decrease. Such plants as sedges, Kentucky bluegrass, western wheatgrass, wiregrass, alder, birch, cottonwood, and willow increase. Invaders are cheatgrass, annual weeds, burdock, cocklebur, hoarhound, rubber rabbitbrush, and big sagebrush.

Woodland

The wooded acreage in the Heber Valley Area occurs as scattered tracts 10 to 75 acres in size of coniferous trees on northern exposures. Engelmann spruce and Douglas-fir, the better timber, have decreased and white fir and Alpine fir have increased in stand density as well as area occupied. The better timber has been harvested without regard to selective cutting or proper woodland management.

The soils are deep, well drained, permeable, and free of lime. In most places the surface is covered with a 1- to 3-inch layer of forest duff and litter. Under this organic material is 3 to 5 inches of very dark brown loam or sandy loam that is gravelly or cobbly in places. Below this, in most places, is a layer of bleached dark-brown cobbly or gravelly loam or sandy loam 12 to 25 inches thick. The subsoil is sandy loam to clay that is cobbly to very gravelly. The parent material is derived from andesite and mixed sedimentary and quartz-diorite porphyry rocks. The total available water capacity to a depth of 5 feet is 5 to 8 inches.

These soils are in the High Mountain climatic zone, which is described in the range section, at elevations of 7,200 to 9,800 feet. At lower elevations these soils are on steep northern exposures.

Alpine fir and Engelmann spruce in mixed stands are the most common conifers. In small areas, almost pure stands of Douglas-fir occur as well as mixed stands of Douglas-fir, Alpine fir, and white fir. Scattered aspen occur in areas of conifer, but aspen is commonly subdominant. There is little or no grazable forage in this woodland.

Past harvesting methods have favored the less desirable trees, Alpine fir and white fir. A selective cutting system is needed. The older, insect-infested, diseased trees and those of poor form should be harvested. The better timber species grow slowly because the poorer species are overstocked. Thinning and stand improvement measures are needed to space desirable trees for proper growth. When the Douglas-fir and Engelmann spruce are harvested, adequate seed trees should be left for natural reproduction.

Commercial markets for aspen wood products are limited in this area, and intensive woodland management has not been practiced. Intensive management may be feasible for aspen trees in areas of high site index. Thinning should start before the trees are 20 years of age. Spacing of 8 by 8 feet is desirable. By age 50 to 60 all the inferior trees should have been removed and the wood crop reduced to 200 to 250 trees for the final cut. The stand should be clear cut in blocks of about 40 acres when the trees reach 60 to 80 years of age. The better trees may not be harvested until they are 90 years old.

Reproduction is entirely from root sprouts, and 3 years after clearcutting as many as 4,000 to 5,000 individual sprouts per acre commonly grow.

The perpetuation of aspen stands is always advisable, because they have great indirect value as a protective cover for watersheds, aside from their commercial value.

Productivity and management

The capacity of a soil to produce wood crops is expressed as site index. Site index is based on the average total height of the dominant and codominant trees in a stand at a specified age. These are the larger trees, the crowns of which form the general level of the forest canopy and occasionally extend above it. Accordingly, on the aspen site that has the highest production the site index is more than 77. On the lowest, it is less than 44. Soils that have a site index between 44 and 77 are intermediate in their wood-producing capacity. The site index rating for aspen is based on table 6 in the U.S. Department of Agriculture Bulletin 1291 (*6*).

The site index for conifers in the survey area is based on Technical Bulletin No. 630, "*Yield of Even-Aged Stands of Ponderosa Pine*" (*4*). The index age is 100 years. The highest producing conifer site has an index rating in excess of 160, and the lowest producing site under 40. It is recognized that ponderosa pine tables are not entirely adequate for determining site index for all conifer species in the survey area; however, tables have not been developed for the other species. The ponderosa pine tables give a relative rating of the conifers on the various soils on which they occur.

Table 3 shows the average site index and the standard deviation of the soils that support woodland.

Table 3 shows the woodland suitability grouping or code on soils in woodland use and their limitations and hazards.

The code is a three-part symbol. The first numeral expresses site quality. Numeral 1 indicates the highest and 5 the lowest. The second part of the symbol shows the limitation. The letter *o* indicates only a slight limitation, *r* indicates slope, and *x* stoniness. The third part distinguishes the groups according to the degrees of difficulty in applying woodland management. A numeral 3, for example, means that woodland management is more difficult to apply than if the numeral were 1 or 2.

Plant competition, as shown in table 3, is expressed as slight, moderate, and severe.

Slight means that competition will not prevent adequate natural regeneration and early growth or interfere with adequate development of planted seedlings.

Moderate means that competition will delay natural or artificial regeneration, both establishment and growth rate, but will not prevent the eventual development of fully stocked normal stands.

Severe means that competition will prevent adequate natural or artificial regeneration without intensive site preparation and maintenance treatments such as weeding.

Seedling Mortality

Slight means that expected mortality is 0 to 25 percent.

Moderate means that expected mortality is between 25 and 50 percent.

Severe means that expected mortality is more than 50 percent.

Forest Pests and Diseases

Slight means that no problems are recognized.

Moderate means that some losses to wood crops may be expected.

Severe means that considerable losses to wood crops may be expected.

Erosion

Slight means that problems of erosion control are unimportant.

Moderate means that some attention must be given to prevent unnecessary soil erosion.

Severe means that intensive treatments, specialized equipment, and methods of operation must be planned to minimize soil erosion.

Windthrow

Slight means that normally no trees are blown down by the wind.

Moderate means that some trees are expected to blow down during periods of excessive soil wetness and high wind.

Severe means that many trees are expected to blow down during periods of soil wetness with moderate or high winds.

Equipment Limitation

Slight means that equipment use is not restricted in kind of equipment or time of year.

Moderate means that equipment use is moderately restricted in kind by one or more factors, such as slope, stones or obstructions, seasonal soil wetness, physical soil characteristics, injury to tree roots, and soil structure and stability.

Severe means that special equipment is needed and its use is severely restricted by one or more of the items listed for "moderate" above, and by safety of operation.

Wildlife Habitat

This section shows, in a general way, the relationship between soils, plants, and water that produces a kind of wildlife habitat. Four kinds are considered in this survey: openland habitat, woodland habitat, wetland habitat, and rangeland habitat. Each has a certain potential for growing specific kinds of plants or for water developments needed by certain kinds of wildlife.

Openland habitat is mainly cropland and pastures, or meadows, lawns, and other areas overgrown with grasses, forbs, shrubs, and vines. Examples of birds and mammals generally common to these areas are quail, pheasants, mourning doves, songbirds, rabbits, and woodchucks.

Woodland habitat is wooded areas containing either hardwood or coniferous trees and shrubs or a mixture of these. Examples of birds and mammals generally common to these areas are grouse, songbirds, woodpeckers, squirrels, deer, elk, and black bear.

Wetland habitat is mainly swampy, marshy, or open-water areas. Examples of birds and mammals generally common to these areas

TABLE 3.—*Wood crops*

[Data apply to named soil only in

Soil series and map symbols	Tree species	Number of plots [1]	Average site index and standard deviation [2]	Woodland suitability	
				Code	Productivity
Baird Hollow: BAC, BAD, BAE, BAF, BCC, BCE, BDC.	Aspen	5	52± 5.2	4o1	Moderate
Cluff: COF, CPC, CPD, CPF, RSC, RSD	Douglas-fir	2	66	5x1	Moderately low
	Alpine fir	2	87	3x1	Moderately high.
	White fir	2	59	5x2	Moderately low.
Daybell: COF, DAF, DBE, DBF, RUF	Aspen	11	61±7.2	3r1	Moderately high
Fitzgerald: DAF	Douglas-fir	1	71	4r1	Moderate
	White fir	1	62	5r1	Moderately low.
Flygare: BCC, BCE, CCD, FBB, FBC, FBD, FLD, FLE, FRE, FRF.	Aspen	7	64± 4.1	3o1	Moderately high
Flygare variant: BDC, FSE	Engelmann spruce	2	50	5r2	Moderately low
	Alpine fir	3	70±10.2	5r3	Moderately low.
Hailman: HAC, HAD, HBF	Aspen	6	53± 5.5	4r2	Moderate
Lake Janee: LAE	Engelmann spruce	2	50	5r2	Moderately low
Roundy: RRC, RRD, RRE, RRF, RSC, RSD, RUF, RYD.	Aspen	12	64± 6.5	3o2	Moderately high
	White fir	3	64±11.0	5o1	Moderately low

[1] Each plot represents 3 to 8 trees, or an average of 5.
[2] Ponderosa pine tables used for fir species. Engelmann spruce tables used for Engelmann spruce.

are ducks, geese, shore birds, muskrat, and beaver.

Rangeland habitat is natural rangeland. Examples of birds and mammals generally common to these areas are chukar, sage grouse, songbirds, elk, deer, and cottontail rabbits.

Table 4 lists the mammals and birds common to the Heber Valley Area and shows the species of major and minor importance for each kind of habitat.

Badgers are strong, sturdy burrowing animals. They prey on burrowing rodents.

Bald eagles are occasionally seen in this survey area. Their food is mainly fish.

Black bears are large powerful animals that inhabit extensive forested lands where human populations are low. They are mainly vegetarian, but will eat carrion, small insects, small mammals, and fish. Their main food is berries, fleshy fruits, and acorns. They inhabit the heavily forested aspen and conifer high mountains.

Beavers are mammal-amphibious flat-tailed rodents that live in streams, rivers, and ponds in which there is an ample food supply. The beaver is a vegetarian, eating chiefly bark or twigs and branches of trees such as aspen, cottonwood, and willows.

Blacktailed jackrabbits typically inhabit the open areas of the plains and deserts, but are also found in Heber Valley. Jackrabbits are vegetarians, eating shrubs, grasses, forbs, and almost any available green plants.

Blue grouse, or *pine hens*, eat mainly bearberry, bluegrass, clovers, dandelion, elderberries, wild lettuce, currants, serviceberry, Douglas-fir nuts, oak, and snowberry. They live in the forested mountains in fall and winter, moving to the lower elevations in spring for nesting.

Bobcats are carnivorous, eating mainly rodents, birds, and rabbits. They will also take young lambs. They range over a wide area, but are commonly in the juniper or pinon areas in the winter and in the oak and aspen areas in the summer.

California quail feed mainly on barley, barnyard grass, corn, millet, oats, pigweed, Indian ricegrass, sunflower, and wheat. Other foods eaten are alfalfa, cheatgrass, dandelion, and rose. Insects taken are ants, beatles, crickets, and grasshoppers. They live mainly in irrigated valleys. Undisturbed grass or weeds, rocks, low shrubs, and brush piles are favorite nesting sites. Loafing cover is provided by dense low shrubs, thick vines, and high weeds. For night roosting, quail require trees or tall shrubs that have stiff twigs and dense foliage. A daily supply of water is essential.

Chukar inhabit rocky slopes and steep areas that have a grass-type food supply. They eat seeds and tender green leaves of both domestic and native plants. They will take ants, beetles, crickets, and grasshoppers. They often congregate at water sites.

and soil-related hazards

mapping units of more than one soil]

Woodland suitability	Hazards or limitations					
Species [3]	Plant competition	Seedling mortality	Forest pests and disease	Erosion	Wind-throw	Equipment limitation
Aspen, Engelmann spruce	Moderate	Slight	Slight	Slight	Slight	Slight.
Douglas-fir, Engelmann spruce, Alpine fir, white fir.	Moderate	Slight	Moderate	Slight	Slight	Slight.
Aspen	Moderate	Slight	Slight	Moderate	Slight	Moderate.
Douglas-fir, white fir	Moderate	Slight	Moderate	Moderate	Slight	Moderate.
Aspen	Moderate	Slight	Slight	Slight	Slight	Slight.
Engelmann spruce, Alpine fir	Moderate	Slight	Moderate	Moderate	Slight	Moderate.
Aspen	Moderate	Slight	Slight	Moderate	Slight	Moderate.
Engelmann spruce, Alpine fir	Moderate	Slight	Moderate	Moderate	Slight	Moderate.
Aspen, Douglas-fir, white fir	Moderate	Slight	Slight	Slight	Slight	Slight.
	Moderate	Slight	Moderate	Slight	Slight	Slight.

[3] Priority in order mentioned.

Cottontails are the most popular small-game animal in the United States. They thrive on farmland where crops, grass, and brush are about equally represented and well distributed. Cottontails are vegetarians and thrive on grasses, clovers, small grain, bark of trees, and many kinds of shrubs. Brush piling is a good way to improve habitat for these small animals.

Cougars are carnivorous animals that eat mainly rodents, rabbits, deer, birds, and such domestic animals as sheep and calves. They live mainly in rugged, remote, mountainous parts of the survey area.

Coyotes are mainly carnivorous, feeding on lambs, birds, lizards, rabbits, rodents, birds, and bird eggs. They range throughout the survey area.

Ducks inhabit ponds, reservoirs, lakes, sloughs, and creeks. Water is essential for all kinds of ducks. Special vegetative cover is necessary during seasons of nesting, rearing broods, and adult moult. Food consists of water-loving plants and aquatic insects. Ducks also feed extensively on domestic grains. They are migratory and respond to habitat development.

Elk eat grass and forbs as first choice. They also eat shrubs, tender parts of trees, and domestic crops. They need easy access to water or snow. Elk find cover in dense woods.

Flying squirrel are small tree squirrels that are seldom seen because they are nocturnal. They inhabit the conifer forests and eat chiefly vegetable matter.

Geese inhabit areas associated with water, such as streams, lakes, or marsh. They nest on islands in rivers or lakes and in trees or on rocky hillsides. They prefer to feed on land on succulent green forages and grains. Both native and domestic plants are used. Rarely do they eat animal foods. Geese are migratory and respond to habitat improvement.

Golden eagles are predatory birds.

Gray partridge (Hun) inhabit irrigated and nonirrigated cropland and grassy foothills. Brush cover is important for escape areas when snow covers the ground. They eat domestic grain and alfalfa, native plant seeds, and insects. They can get by with water obtained from vegetation and insects, but will use open water when available. They do not concentrate near waterholes.

Ground squirrels are of two species in the survey area, Townsend and Uinta. They eat some insects but are primarily vegetarian.

Mourning doves inhabit open areas but are versatile in habitat needs. They are found mostly in irrigated valleys, but are also common in nonirrigated areas. They nest in trees, shrubs, or on the ground. They are primarily seed eaters and require water daily. These birds are migratory.

Mule deer eat a wide variety of shrubs, forbs, and grasses. They also eat acorns, fruits, tender parts of trees, and domestic crops. Deer

TABLE 4.—*Mammals and birds common to Heber Valley Area*

[X indicates minor importance, XX indicates major importance. Asterisk identifies rare or endangered species or species of undetermined but questionable status]

Species of wildlife	Type of habitat			
	Openland	Woodland	Wetland	Rangeland
Badger	X			XX
Bald eagle			X	XX
Black bear		XX		
Beaver			XX	
Black-tailed jackrabbit	X			XX
Blue grouse		XX		
Bobcat		X		XX
California quail	XX			X
Chukar				XX
Cottontail	XX			X
Cougar		XX		XX
Coyote		X		XX
Ducks			XX	
Elk		XX		
Flying squirrel		XX		
Geese	X		XX	
Golden eagle				XX
Gray partridge	XX			X
Ground squirrel		XX		X
Mourning dove	XX			X
Mule deer		X		XX
Muskrat			XX	
Peregrine falcon*			X	XX
Pine martin*		XX		
Porcupine		XX		
Ring-necked pheasant	XX	XX		
Ruffed grouse		XX		
Sage grouse				XX
Shore birds and California gull			XX	
Skunk	XX		X	
Snowshoe hare		XX		
Song birds	X	XX	X	X
Nongame birds				
Trout			XX	
Weasel	X	XX		XX
Woodchuck	X			XX

drink frequently and may use snow for water at times. They also like salt. They find cover in woodlands, brushy areas, and canyons. Deer feed from early evening through the night and early morning.

Muskrat are semiaquatic and need water to live. They build dome shaped lodges of vegetation and mud, high enough to keep their living rooms above water. Entrance to their house is below the water line. They eat mostly leaves and roots of aquatic vegetation but also forage for domestic crops.

Peregrine falcon are rare or endangered birds.

Pine martin are classified as undetermined. They can occasionally be seen.

Porcupine are large rodents having sharp bristles or quills. They feed mostly on bark of conifers.

Ring-necked pheasant inhabit the irrigated valleys. They use well-drained uplands and poorly drained areas of cover. Roadsides, weed patches, fence rows, ditchbanks, willow patches, grass and brush areas, hayfields, and grainfields are all used for cover and nesting. Pheasants eat weed seeds, grains, tender plants, fruits, berries, and insects. Water is important and may be taken from plants and insects or as dew if open water is not available.

Ruffed grouse inhabit thickets of deciduous trees and shrubs interspersed with conifers and adjacent to streams or springs. Food consists of tree buds, fruit, seeds, berries, and green vegetation. Green vegetation may furnish daily water requirements if open water is not available.

Sage grouse inhabit range producing sagebrush, grasses, and forbs as a basic requirement.

Wet meadows in a sagebrush habitat are important. Sage grouse migrate to higher and lower elevations depending on the season. Strutting areas are also important. Sage grouse have a thin-walled stomach rather than a gizzard. Food consists of sagebrush leaves and leafy part of native and domestic plants. They eat some insects but no seeds.

Shore birds and California gull are typical migrant birds that may be found in the wetland areas. These include the California gull, great blue heron, common snipe, spotted sandpiper, American avocet, and killdeer. These birds feed primarily on aquatic animals, insects, fish, and crustaceans.

Skunks inhabit the valley areas. They feed on adult and larval insects, especially on grasshoppers, grubs, crickets, beetles, and wasps. Spiders are commonly eaten, as are toads, frogs, lizards, mice, gophers, and bird eggs. Plant materials ordinarily constitute only a small part of the diet.

Snowshoe hare inhabit the forested areas and to some extent the upland valley. They turn white in winter and brownish the rest of the year. Their food consists of herbage in the summer and bark and twigs in the winter.

Songbirds such as blackbirds, finches, and sparrows eat mainly dry seeds, grains, grasses, and weeds. Robins, thrushes, bluebirds, and waxwings eat mainly berries, fruit, and insects. Swallows, nighthawks, and flycatchers eat flying insects caught on the wing. Woodpeckers, chickadees, nuthatches, and warblers eat insects, their eggs, and larvae. Songbirds ordinarily find nesting sites in fields, pastures, orchards, ponds, fence rows, streambank areas, and abandoned farmsteads.

Trout inhabit the streams, lakes, and reservoirs. Provo River and Deer Creek Reservoir are heavily fished. The State maintains a fish hatchery near Midway.

Weasels prey most commonly on rabbits, mice, squirrels, gophers, and other rodents, birds, and their eggs, snakes, frogs, and fish. Weasels are vicious predators that are fairly common throughout the survey area, except at the higher elevations.

Woodchucks are marmots. They live in rocky, ledgy areas and are vegetarians.

Wildlife suitability groups

Table 5 shows the potential of soils, by wildlife suitability groups, for the elements and kinds of wildlife habitat.

Each soil in the Heber Valley Area has been assigned to one of 10 groups, according to its suitability for improvement, maintenance, or creation of each of the habitat elements and kinds of habitat.

In Utah, wildlife groups are designated by a symbol that represents suitability for a kind of wildlife habitat. The first numeral is for openland habitat, the second for woodland habitat, the third for wetland habitat, and the fourth for rangeland habitat. Number 1 means good; 2, fair; 3, poor; and 4 very poor. For example, wildlife group 3242 is poor for openland habitat, fair for woodland, very poor for wetland, and fair for rangeland. The letter I following the numeral symbol means that the soils are irrigated.

Knowing the properties of named kinds of soils makes it possible to predict how soils will behave under various vegetative and water management practices. Proper handling of soils, water, and plants to produce a suitable habitat is the most effective way to maintain and improve wildlife populations.

Soils are rated on their suitability for eight general plant groups or water development groups, called habitat elements. These are (1) grain and seed crops, (2) domestic grasses and legumes, (3) wild herbaceous plants, (4) hardwood trees, (5) coniferous trees, (6) shrubs, (7) wetland plants, and (8) shallow water areas.

Soil suitability is expressed by an adjective rating as follows:

Good means few or no soil limitations. Wildlife habitats are easily improved, maintained, or created.

Fair means moderate soil limitations. Habitat can be improved, maintained, or created, but soil limitations affect wildlife habitat development or management.

Poor means severe soil limitations. Wildlife habitat can be improved, maintained, or created, but habitat management may be difficult and expensive, and requires intensive effort.

Very poor means soils are such that it is impractical to attempt to improve, maintain, or create wildlife habitats. Unsatisfactory results are probable.

WILDLIFE GROUP 2121-I

The soils in this group are fair for openland and wetland habitat and good for woodland and rangeland habitat. They are deep, somewhat poorly drained soils on terraces and flood plains along streams. Their surface layer is mainly loam, and underlying layers are clay loam and sandy clay loam. Cobbles and gravel occur at varying depths below 30 inches, and sand or sand and gravel are common below 40 inches. Slopes are 0 to 5 percent.

The average annual precipitation is 16 to 20 inches. Water available to plants is about 5 to 9 inches. The mean annual temperature is 44° or 45° F, and the frost-free period is 70 to 90 days. The water table generally fluctuates between depths of 20 and 36 inches. The vegetation is mainly irrigated native pasture or hay and some alfalfa, small grain, and domestic pasture grasses.

Important wildlife species are jackrabbits, cottontail rabbits, sharp-tailed grouse, mourning doves, geese, and songbirds.

WILDLIFE GROUP 2131-I

The soils in this group provide fair openland habitat, good woodland and rangeland habitats, and poor wetland habitat. The only soils in this group are Fluventic Haploborolls, sandy-skeletal. Generally, their surface layer is loam or sandy loam 6 to 15

TABLE 5.—*Potential, by wildlife groups,*

Wildlife suitability group	Potential for habitat elements				
	Grain and seed crops	Grass and legume crops	Wild herbaceous plants	Hardwood trees	Conifer trees
2121-I	Fair	Fair	Good	Good	
2131-I	Poor	Poor	Good	Good	
2141	Fair	Fair	Good	Good	
2141-I	Fair	Fair	Good	Good	
2222-I	Poor	Fair	Fair	Fair	
3141	Very poor	Very poor	Good		Good
3242	Very poor	Very poor	Fair	Fair	
3242-I	Poor	Poor	Fair	Poor	
4343	Very poor	Very poor	Poor		Poor
4444	Very poor	Very poor	Very poor	Very poor	

inches thick over gravel, or sand and gravel, but texture and thickness of the soil are highly variable within a very short distance. The soils are gravelly, cobbly, or stony in places.

These soils are intermixed along the stream bottoms and narrow canyons. Slopes are 1 to 10 percent. The water table fluctuates with streamflow, but is normally between depths of 2 and 5 feet. Many areas are flooded briefly in most years. The average annual precipitation is 16 to 24 inches. The water-supplying capacity is about 11 to 14 inches because of the water table and flooding. The mean annual temperature is 43° to 46° F. The frost-free period is mainly 70 to 90 days, but is only 50 to 70 days in the higher canyons. The native vegetation is cottonwoods, willows, and hawthorn and an understory of grasses, forbs, and shrubs. Important wildlife species are California quail, cottontail rabbit, beaver, mule deer, songbirds, jackrabbit, sharp-tailed grouse, and Uintah ground squirrel.

WILDLIFE GROUP 2141

The soils in this group provide fair openland habitat, good woodland and rangeland habitat, and very poor wetland habitat. They are deep and well drained. Generally, their surface layer is loam and their subsoil is loam, clay loam, or clay. In some places the surface layer is gravelly, cobbly, or very cobbly.

These soils are on alluvial fans, terraces, and lower mountainsides. Slopes are 5 to 40 percent. The average annual precipitation is 16 to 24 inches. The water-supplying capacity is 11 to 18 inches. The mean annual temperature is 43° to 46° F, and the frost-free period is 50 to 90 days. The native vegetation is mainly oakbrush, big sagebrush, snowberry, bitterbrush, serviceberry, bluebunch wheatgrass, and other related grasses and forbs. The wildlife species most commonly found here are cottontail rabbit, Hungarian partridge, mule deer especially in winter, sage grouse, jackrabbit, and Uintah ground squirrel.

WILDLIFE GROUP 2141-I

The soils in this group provide fair openland habitat, good woodland and rangeland habitat, and very poor wetland habitat. They are deep and well drained. Generally, their surface layer is loam, and their subsoil is loam, clay loam, and clay. In some places the surface layer is cobbly.

These irrigated soils are on alluvial fans and terraces. Slopes are mainly 1 to 15 percent but range to 25 percent in places. The average annual precipitation is 16 to about 20 inches. These soils hold 5 to 11 inches of water available to plants. The mean annual temperature is about 43° to 45° F, and the frost-free period is about 70 to 90 days. The main crops are alfalfa, pasture grasses, and such small grain as wheat and barley. The wildlife species most commonly grown in these irrigated areas are cottontail rabbit, jackrabbit, mule deer, especially next to range areas, and mourning dove.

WILDLIFE GROUP 2222-I

The soils in this group provide fair habitat for all four types of wildlife. They are mainly deep and poorly drained. Textures range from loam to silty clay. In many places they are cobbly below a depth of about 30 inches, and in some places gravelly sand or sand is below a depth of about 40 inches.

These soils are on the flood plains and low terraces of the streams. Slopes are 1 to 3 percent. Also in this group are soils in seep areas on sloping alluvial fans and soils that are underlain by travertine bedrock at a depth of 10 to 30 inches. The average annual precipitation is 16 to 20 inches. The available water capacity is about 5 to 10 inches if the soils are drained. The mean annual temperature is 44° to 46° F, and the frost-free period is about 70 to 90 days. The water table is at a depth between 10 and 20 inches much of the time. The vegetation is mainly sedges, rushes, timothy, redtop, and related plants. The dominant wildlife species in these areas are muskrat, beaver, ducks, geese, mourning dove, shore birds, and songbirds.

WILDLIFE GROUP 3141

The soils in this group provide poor openland habitat, good woodland and rangeland habitat, and very poor wetland habitat. These soils are deep and are well drained and in places somewhat excessively drained. Their surface layer is loam in most areas, but is cobbly or gravelly in some places and very cobbly in a few places.

The larger acreage of these soils is in high moun-

for elements and kinds of habitat

Potential for habitat elements			Potential for kinds of habitat			
Shrubs	Wetland plants	Shallow water	Openland	Woodland	Wetland	Rangeland
Good	Fair	Fair	Fair	Good	Fair	Good.
Good	Poor	Poor	Fair	Good	Poor	Good.
Good	Very poor	Very poor	Fair	Good	Very poor	Good.
Good	Very poor	Very poor	Fair	Good	Very poor	Good.
Fair	Good	Fair	Fair	Fair	Fair	Fair.
Good	Very poor	Very poor	Poor	Good	Very poor	Good.
Fair	Very poor	Very poor	Poor	Fair	Very poor	Fair.
Fair	Very poor	Very poor	Poor	Fair	Very poor	Fair.
Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.

tainous areas. Slopes are 3 to 65 percent. The average annual precipitation is 25 to 35 inches. The water-supplying capacity is about 11 to 21 inches. The mean annual temperature is about 39° F, and the frost-free period is less than 50 days. The vegetation is aspen or mixed aspen and conifers. Grassy or shrubby parks and dense stands of spruce and fir are on northerly slopes. These areas provide summer range for deer, elk, and moose and habitat for blue (pine) grouse, ruffed grouse, and snowshoe hare.

The smaller acreage is in mountainous areas at lower elevations. Slopes are mainly 40 to 60 percent, but range from 15 to 60 percent. The average annual precipitation is 18 to 25 inches. The water-supplying capacity is about 11 to 18 inches. The mean annual temperature is about 43° to 45° F, and the frost-free period is 50 to 70 days. The vegetation is oakbrush, big sagebrush, snowberry, bitterbrush, bluebunch wheatgrass, and related grasses and forbs. The wildlife species most commonly found here are blue grouse, chukar, cougar, golden eagle, elk, mule deer, and Uintah ground squirrel. Deer and elk winter at the lower elevations.

WILDLIFE GROUP 3242

The soils in this group provide poor openland habitat, fair woodland and rangeland habitat, and very poor wetland habitat. They are deep and well drained. Their surface layer is mostly very cobbly fine sandy loam, but in some places it is fine sandy loam. The subsoil is very cobbly or very gravelly.

These soils are on steep and very steep mountainsides and very cobbly old stream terraces of the valleys. Slopes are mainly 15 to 65 percent, but in a few areas in the valleys they are 1 to 3 percent. The average annual precipitation is mainly 18 to 25 inches but ranges to 16 inches in the valleys. The water-supplying capacity is 6 to 10 inches. The mean annual temperature is about 44° to 45° F. The frost-free period is commonly 50 to 70 days, but it is 70 to 90 days in the valleys. The native vegetation is oakbrush, big sagebrush, snowberry, wheatgrasses, and native bluegrasses. The dominant wildlife species are mule deer, sage grouse, chukar, golden eagle, Uintah ground squirrel, and woodchuck.

WILDLIFE GHOUP 3242-1

The soils in this group provide poor openland habitat, fair woodland and rangeland habitat, and generally very poor wetland habitat. They are mainly deep, but some are shallow. Generally their surface layer is cobbly or gravelly.

These soils are in the irrigated valleys mainly on stream terraces and alluvial fans, but some are on the travertine benches near Midway. Slopes range from 1 to 25 percent but are mainly 1 to 15 percent. The average annual precipitation is mainly 16 to 18 inches but ranges to about 22 inches in places. The available water capacity is 2 to 4 inches. The mean annual temperature is 44° to 46° F, and the frost-free period is 80 to 90 days for most of the soils. Crops mostly are alfalfa, small grain, and pasture. The most common wildlife species in these irrigated areas are cottontail rabbit, jackrabbit, songbirds, and mourning dove and on areas adjacent to rangeland, mule deer.

WILDLIFE GROUP 4343

The soils in this group provide very poor openland and wetland habitat and poor wetland and rangeland habitat. They are shallow soils that are cobbly or very cobbly and have textures that range from sandy loam to sandy clay loam.

These soils are on mountains. Slopes are 6 to 70 percent. The average annual precipitation is 18 to 25 inches, and the water-supplying capacity is about 3 to 6 inches. The mean annual temperature is 43° to 45° F, and the frost-free period is 50 to 70 days. The native vegetation is big sagebrush, curlleaf and birchleaf mountainmahogany, some oakbrush, and snowberry.

The dominant wildlife species in these areas are sage grouse, golden eagle, mule deer, and elk. Deer and elk may winter in the areas.

WILDLIFE GROUP 4444

The land types and soil in this group provide very poor habitat for all four kinds of wildlife. These areas consist of barren rock outcrops, Rock land that has 4 inches or less of soil material, and shallow very cobbly loamy sand that is 10 to 20 inches deep over sandstone bedrock. Slopes are 0 to 80 percent.

The average annual precipitation is about 18 to 24 inches. The water-supplying capacity ranges from 0 on the barren rocks to about 2.5 inches, except in the small pockets of deeper soils that are included. The

mean annual temperature is 43° to 45° F, and the frost-free period is 50 to 90 days. The vegetation is sparse and varies widely with changes in elevation and parent rocks. Curlleaf mountainmahogany, big sagebrush, and bunchgrasses are common to most of the areas.

These areas support very little wildlife but are traversed by the species common to the surrounding lands. The larger rocky areas provide nesting places for eagles.

Recreation

About 24,000 acres of mountainous and farm land on the west side of Heber Valley is to be used as a State park for camping, picnic areas, golfing, and other recreation. Lodges, cabins, skiing, and ice skating facilities and an aerial tramway are planned for the park.

This Area is becoming important as a tourist resort. The natural hot water from the travertine "hot pots" is used in swimming pools. The scenic beauty of the Area is attracting national attention. Resorts in the Area are renowned for their hotel accommodations, eating establishments, and riding horses and are visited by more than 100,000 people each year.

A road between this area and the Brighton ski area, east of Salt Lake City, has recently been opened. Also a road between this area and Park City to the north is opened. At present they are closed in winter. Highways to the east, west, and north are paved and open all year. These facilities make Deer Creek Reservoir, the Provo River, and the State Park easily accessible for recreational uses.

Table 6 shows limitations of soils for camp and picnic areas, and paths and trails. Soils that have slopes greater than 25 percent are very severely limited and are not listed.

Engineering Applications[3]

It is not intended that the information in this survey eliminate the need for onsite sampling and testing of soils for design and construction of specific engineering works and use. Interpretations should be used primarily in planning for more detailed field investigations to determine the condition of soil material in place at the proposed site.

Engineers need to know the properties of soils to determine their effect on construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, irrigation systems, and sewage disposal systems. Among the important properties are internal friction, cohesion, permeability, compressibility, drainage, volume-change characteristics, particle-size distribution, plastic limit, liquid limit, and pH. Topography, depth to water table, and depth to bedrock are also important. The combination of these properties indicates the mechanical and hydrologic suitability of the soil for engineering use.

The information in the survey can be used to—

1. Make soil and land use studies that will aid in the selection and development of industrial, business, residential, summer home, and recreation sites.
2. Make reconnaissance estimates of the engineering properties of soils in planning agricultural drainage systems, farm ponds, irrigation systems, and erosion control structures.
3. Locate probable sources of sand, gravel, clay, and other construction material.
4. Make reconnaissance surveys of soils and foundation sites that will help in selecting locations for highways, airports, and pipelines and in planning detailed soils investigations for these locations.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps and reports and aerial photographs for the purpose of making maps and reports that can be used readily by engineers.

The use of the data from tables 7 and 8 and the soil maps provides a preliminary evaluation of the engineering properties of the soil at any specific location within the soil survey area.

Soil classification

Two different systems of soil classification are used in this section. They are the Unified Soil Classification system (*10*), and the American Association of State Highway Officials system (*1*). The engineer using this report should be familiar with these systems.

The American Association of State Highway Officials (AASHO) system of classifying soils is an engineering-property classification based on field performance of highways, and it is the system most widely known and used in highway practice.

Grouping soils of about the same general load-carrying capacity and service characteristics resulted in seven basic groups that were designated A–1 to A–7. The best soils for road subgrade are classified as A–1, the next A–2, etc., and the poorest soils are classified A–7.

In the AASHO system, engineers use the terms "silty" or "clayey" to refer to the plasticity index of the soil. The term "silty" is applied to fine material having a plasticity index of 10 or less, and the term "clayey" is applied to fine material having a plasticity index of 11 or greater. These values are important in the determination of the basic groups A–1 to A–7.

The Unified Soil Classification system applies to embankments and foundations as well as to roads and airfields. It is used by the Corps of Engineers, Bureau of Reclamation, and the Soil Conservation Service. It is based on identification of soils according to their texture and plasticity, and it groups them

[3] This section was prepared mainly by GILBERT P. SEARLE, engineer, and LOWELL WOODWARD and EARL JENSEN, soil scientists, Soil Conservation Service.

TABLE 6.—*Limitations of soils for camp and picnic areas, paths, and trails*

[Soils that have slopes of more than 25 percent have severe limitations and are not listed]

Map symbol	Soil	Camps and picnic areas	Paths and trails
BAC	Baird Hollow loam, 6 to 15 percent slopes	Moderate: slope	Slight.
BAD	Baird Hollow loam, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
BCC	Baird Hollow-Flygare association, moderately steep:		
	Baird Hollow soil	Moderate: slope	Slight.
	Flygare soil	Severe: cobbles	Severe: cobbles.
BDC	Baird Hollow association, moderately steep	Moderate: slope	Slight.
BeD2	Bezzant cobbly loam, 10 to 20 percent slopes, eroded	Moderate: slope	Slight.
BfC	Bezzant very cobbly loam, 6 to 10 percent slopes	Severe: cobbles	Severe: cobbles.
BPC	Broadhead-Little Pole association, moderately steep:		
	Broadhead soil	Moderate: slope	Slight.
	Little Pole soil	Severe: cobbles	Severe: cobbles.
BPD	Broadhead-Little Pole association, hilly:		
	Broadhead soil	Severe: slope	Moderate: slope.
	Little Pole soil	Severe: cobbles	Severe: cobbles.
BTC	Broadhead soils, 6 to 15 percent slopes	Moderate: slope	Slight.
BTD	Broadhead soils, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
BVC	Buell gravelly loam, 6 to 15 percent slopes	Moderate: slope	Slight.
BVD	Buell gravelly loam, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
Ca	Center Creek loam	Moderate: seasonal water table	Slight.
CBB	Clayburn loam, 3 to 6 percent slopes	Slight	Slight.
CBC	Clayburn loam, 6 to 15 percent slopes	Moderate: slope	Slight.
CBD	Clayburn loam, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
CCD	Clayburn-Flygare association, hilly	Severe: slope	Moderate: slope.
CgA	Clegg loam, 1 to 3 percent slopes	Slight	Slight.
CgB	Clegg loam, 3 to 6 percent slopes	Slight	Slight.
CgC	Clegg loam, 6 to 15 percent slopes	Slight	Slight.
ChC	Clegg cobbly loam, 5 to 10 percent slopes	Slight	Slight.
CMD	Cloud Rim loam, 10 to 25 percent slopes	Severe: slope	Moderate: slope.
CPC	Cluff soils, 6 to 15 percent slopes	Moderate: slope	Slight.
CPD	Cluff soils, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
CrA	Crooked Creek clay loam, 1 to 3 percent slopes	Severe: shallow water table	Severe: shallow water table.
Cv	Cudahy silt loam, cold variant	Severe: shallow water table	Severe: shallow water table.
Cw	Cudahy silt loam, cold variant, moderately deep water table.	Severe: shallow water table	Severe: shallow water table.
DcA	Deer Creek loam, 1 to 3 percent slopes	Slight	Slight.
DcC	Deer Creek loam, 3 to 10 percent slopes	Slight	Slight.
DWC	Deer Creek-Watkins Ridge complex, 6 to 15 percent slopes.	Moderate: slope	Slight.
DWD	Deer Creek-Watkins Ridge complex, 15 to 25 percent slopes.	Severe: slope	Moderate: slope.
FA	Fluventic Haploborolls	Severe: shallow water table	Severe: shallow water table.
FBB	Flygare loam, 3 to 6 percent slopes	Slight	Slight.
FBC	Flygare loam, 6 to 15 percent slopes	Moderate: slope	Slight.
FBD	Flygare loam, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
FLD	Flygare-Little Pole association, hilly:		
	Flygare loam, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
	Little Pole very cobbly sandy clay loam, 6 to 25 percent slopes.	Severe: cobbles	Severe: cobbles.
GAD	Gappmayer gravelly fine sandy loam, 15 to 25 percent slopes.	Severe: slope	Moderate: slope.
HAC	Hailman loam, 6 to 15 percent slopes	Moderate: slope	Slight.
HAD	Hailman loam, 15 to 30 percent slopes	Severe: slope	Moderate: slope.
HeA	Henefer silt loam, 1 to 3 percent slopes	Slight	Slight.
HeC	Henefer silt loam, 6 to 10 percent slopes	Slight	Slight.
HeD	Henefer silt loam, 10 to 25 percent slopes	Moderate: slope	Slight.
HJC	Henefer soils, 6 to 10 percent slopes	Moderate: slope	Slight.
HJD	Henefer soils, 10 to 25 percent slopes	Severe: slope	Moderate: slope.
Hk	Holmes cobbly sandy loam	Moderate: cobbles	Moderate: cobbles.
Hm	Holmes cobbly sandy loam, channeled	Moderate: cobbles	Moderate: cobbles.
Ho	Holmes very cobbly sandy loam	Severe: cobbles	Severe: cobbles.
Hr	Holmes gravelly loam	Moderate: gravel	Slight.
HWC	Horrocks-Broadhead association, moderately steep:		
	Horrocks very cobbly sandy clay loam, 6 to 15 percent slopes.	Severe: cobbles	Severe: cobbles.
	Broadhead loam, 6 to 15 percent slopes	Moderate: slope	Slight.
Kc	Kovich loam	Severe: shallow water table	Severe: shallow water table.
Kd	Kovich loam, channeled	Severe: shallow water table	Severe: shallow water table.
Kh	Kovich loam, moderately deep water table	Severe: shallow water table	Severe: shallow water table.
Km	Kovich loam, deep water table variant	Moderate: seasonal water table	Moderate: seasonal water table.
Kp	Kovich loam, gravelly subsoil variant	Severe: shallow water table	Severe: shallow water table.
Kr	Kovich loam, gravelly subsoil variant, channeled	Severe: shallow water table	Severe: shallow water table.

TABLE 6.—*Limitations of soils for camp and picnic areas, paths, and trails*—Continued

[Soils that have slopes of more than 25 percent have severe limitations and are not listed]

Map symbol	Soil	Camps and picnic areas	Paths and trails
Ks	Kovich loam, gravelly subsoil variant, moderately deep water table.	Severe: shallow water table	Severe: shallow water table.
LPD	Little Pole very cobbly sandy clay loam, 6 to 25 percent slopes.	Severe: cobbles	Severe: cobbles.
Lr	Logan silty clay, cold variant	Severe: water table	Severe: water table.
MaB	Manila silt loam, 3 to 6 percent slopes	Slight	Slight.
MaC	Manila silt loam, 6 to 10 percent slopes	Slight	Slight.
MaD	Manila silt loam, 10 to 20 percent slopes	Moderate: slope	Slight.
MSD	Mult soils, thick solum variant, 5 to 25 percent slopes	Slight	Slight.
RaB	Rasband coarse sandy loam, 3 to 6 percent slopes	Slight	Slight.
RCC	Rasband coarse sandy loam, 6 to 15 percent slopes	Slight	Slight.
RdA	Rasband loam, 1 to 3 percent slopes	Slight	Slight.
RdC	Rasband loam, 3 to 10 percent slopes	Slight	Slight.
RRC	Roundy loam, 5 to 15 percent slopes	Moderate: slope	Slight.
RRD	Roundy loam, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
RSC	Roundy-Cluff association, moderately steep	Moderate: slope	Slight.
RSD	Roundy-Cluff association, hilly	Severe: slope	Moderate: slope.
RYD	Roundy soils, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
SEC	Sessions clay loam, 5 to 15 percent slopes	Moderate: slope	Slight.
SED	Sessions clay loam, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
SpB	Spaa silt loam, 2 to 5 percent slopes	Slight	Slight.
St	Steed loam, cold variant	Slight	Slight.
Sv	Steed cobbly loam, cold variant	Moderate: cobbles	Moderate: cobbles.
WcC	Watkins Ridge silt loam, 6 to 15 percent slopes	Moderate: slope	Slight.
WcD	Watkins Ridge silt loam, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
WLC	Watkins Ridge-Clegg complex, 6 to 15 percent slopes	Moderate: slope	Slight.
WLD	Watkins Ridge-Clegg complex, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
WNC	Watkins Ridge-Deer Creek complex, 6 to 15 percent slopes.	Moderate: slope	Slight.
WND	Watkins Ridge-Deer Creek complex, 15 to 25 percent slopes.	Severe: slope	Moderate: slope.
WSC	Whipstock soils, 6 to 15 percent slopes	Moderate: slope	Slight.
WSD	Whipstock soils, 15 to 25 percent slopes	Severe: slope	Moderate: slope.
YaB	Yeates Hollow loam, 2 to 5 percent slopes	Slight	Slight.
YEC	Yeates Hollow very cobbly loam, 6 to 15 percent slopes	Severe: cobbles	Severe: cobbles.
YED	Yeates Hollow very cobbly loam, 15 to 25 percent slopes.	Severe: cobbles	Severe: cobbles.
YTC	Yestes Hollow-Henefer association, moderately steep:		
	Yestes Hollow very cobbly loam, 6 to 15 percent slopes.	Severe: cobbles	Severe: cobbles.
	Henefer silt loam, 6 to 15 percent slopes	Moderate: slope	Slight.
YTD	Yeates Hollow-Henefer association, hilly:		
	Yeates Hollow very cobbly loam, 15 to 25 percent slopes.	Severe: cobbles	Severe: cobbles.
	Henefer silt loam, 15 to 25 percent slopes	Severe: slope	Moderate: slope.

TABLE 7.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the first column. The symbol > means

Soil series and map symbols	Hydrologic group	Depth to—		Depth from surface	USDA texture	Soil classification		Coarse fragments more than 3 inches in diameter
		Water table	Bedrock			Unified	AASHO	
		Inches	*Inches*	*Inches*				*Percent*
*Agassiz:[2] AGF, AWF. For Wallsburg soils in AWF, refer to Wallsburg series.	D	>60	12–20	0–13 13	Very cobbly loam Limestone bedrock.	SC	A–6	55–75
*Baird Hollow: BAC, BAD, BAE, BAF, BCC, BCE, BDC. For Flygare soil in BCC and BCE, refer to Flygare series; for Flygare soil in BDC, refer to Flygare variant.	C	>60	>60	0–29 29–72	Cobbly loam, loam, and clay loam. Cobbly clay	CL CL	A–6 A–7 or A–6	15–45 35–50

with respect to performance as engineering construction materials. The following properties form the basis of soil identification:

1. Percentages of gravel, sand, and fines (fraction passing the No. 200 sieve). In the Unified Soil Classification system, the terms silt and clay are used to separate the fines into soils where Atterberg limits are above and below "A" line on the plasticity chart.
2. Shape of the grain-size distribution curve.
3. Plasticity and compressibility characteristics.

The soil is given a descriptive name and a letter symbol indicating its principal characteristics. The following letter symbols occur in this survey:

GW—Well graded gravels, gravel-sand mixtures, little or no fines.
GP—Poorly graded gravels, gravel and sand mixture, little or no fines.
GM—Silty gravels, gravelly sand-silt mixtures.
GC—Clayey gravels, gravel, sand, clay mixtures.
SW—Well graded sands, gravelly sands, little or no fines.
SP—Poorly graded sands, little or no fines.
SM—Silty sands, sand-silt mixtures.
SC—Clayey sands, sand-clay mixtures.
ML—Inorganic silts and very fine sands of slight plasticity.
CL—Inorganic clays of low to medium plasticity, silty clays.
OL—Organic silts and organic silty clay loams of low plasticity.
MH—Inorganic fine sandy or silty soil of high plasticity.
CH—Inorganic clays of high plasticity.
OH—Organic clays of medium to high plasticity, organic silts.
PO—Peat and other highly organic soils.

Soil test data

All engineering properties of the soil in this section are based on soil survey laboratory reports from the laboratory at Logan, Utah, and on field observations. Adjustment of the particle-size distribution had to be made because the testing was done for USDA textural classification. The cobble-size particles were removed before the sample was sent to the laboratory for testing. The cobble estimate was taken from the soil description made by the soil scientist.

The soil fines were classified silt or clay on the basis of field examination and laboratory reports. There were no laboratory data available on the liquid limit and plasticity index of the soil fines. Estimated values are given for liquid limit, plasticity index, permeability, available water capacity, hydrologic group, shrink-swell potential, and potential frost action.

The laboratory reports were based on a sieve analysis system for textural classification, and from this analysis estimates of the percentage passing a given sieve were made.

Table 7 gives a description of the soils and their estimated physical and chemical properties.

Salinity is not indicated in table 7 because most soils in the survey area are not affected by salt or alkali. The exceptions are the typically wet Crooked Creek, Cudahy cold variant, and Logan cold variant soils, and they are only slightly affected.

The U.S. Department of Agriculture classification system has terms and definitions used for soil texture that are not known to all engineers.

Clay.—A soil separate or size group of mineral particles less than 0.002 millimeters in diameter.
Silt.—A soil separate or size group of mineral particles having a diameter range from 0.002 to 0.05 millimeters (No. 270 sieve).
Sand.—A soil separate or size group of mineral particles having a diameter range from 0.05 (No. 270 sieve) to 2.0 millimeters (No. 10 sieve).
Gravel.—A coarse fragment of mineral particles ranging in diameter from 2.0 millimeters (No. 10 sieve) to 3 inches.
Cobble.—A coarse fragment of mineral particles ranging in diameter from 3 to 10 inches.

Other textural class names have specific definitions

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different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear more than; the symbol < means less than]

Percentage passing sieve [1]				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Potential frost action
No. 4 (4.76 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
				Percent		*In per hr*	*In per in.*	*pH*		
70–80	65–75	55–65	40–50	30–40	10–15	0.6–2.0	0.07–0.1	[3] 7.4–8.4	Low	Moderate.
80–90	75–85	65–75	50–60	30–40	10–20	0.6–2.0	0.1–0.14	5.6–6.5	Moderate	Moderate to high.
85–95	80–90	60–70	50–65	35–45	15–25	0.06–0.2	0.07–0.1	4.5–5.5	Moderate	Moderate.

TABLE 7.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the first column. The symbol > means

Soil series and map symbols	Hydrologic group	Depth to—		Depth from surface	USDA texture	Soil classification		Coarse fragments more than 3 inches in diameter
		Water table	Bedrock			Unified	AASHO	
Bezzant: BeD2, BfC, BGE	B	>60	>120	60	Cobbly or very cobbly loam or clay loam.	ML	A-4	30-50
Brad:[2] BHF No interpretations for Rock outcrop.	D	>60	10-20	0-10 10	Very cobbly loamy sand Flaggy sandstone.	SM	A-1 or A-2	55-90
*Bradshaw: BKF, BLF, BMF For Henefer soil in BLF, refer to Henefer series; for Wallsburg soil in BMF, refer to Wallsburg series.		>60	>60	0-62	Very cobbly very fine sandy loam and very cobbly loam.	GM	A-1	40-50
*Broadhead: BOE, BPC, BPD, BPE, BPF, BTC, BTD, BTE, BTF. For Little Pole soil in BPC, BPD, BPE, and BPF, refer to Little Pole series.	C	>60	>60	0-12 12-44 44-60	Loam, cobbly loam, or very cobbly loam. Clay Silt loam, cobbly silt loam	CL CL CL or CL-ML	A-6 A-7 A-4	0-60 0-10 5-30
Buell: BVC, BVD, BVF	A	>60	>60	0-60	Gravelly loam, very gravelly loam.	GC, GC-GM	A-2	5-30
*Burgi: BWE, BWF, BXF, BYF. For Agassiz soil in BXF, refer to Agassiz series; for Wallsburg soil in BYF, refer to Wallsburg series.	B	>60	>60	0-12 12-60	Gravelly loam Gravelly loam	CL-ML or CL SC-SM or SC	A-4 A-2 or A-4	5-10 5-10
Center Creek: Ca	B	36-60	>60	0-33 33-60	Loam, clay loam Very gravelly sandy loam or sandy clay loam.	CL GC or GC-GM	A-6 A-2	--- 10-15
*Clayburn: CBB, CBC, CBD, CCD, CDE. For Flygare soil in CCD, refer to Flygare series.	B	>60	>60	0-41 41-60	Loam, sandy clay loam Gravelly sandy loam	CL SC	A-6 A-2	0-20 5-10
Clegg: CgA, CgB, CgC, ChC	B	>60	>60	0-21 21-66	Loam, cobbly loam Loam	CL CL-ML or CL	A-6 A-4	0-5 5-20
Cloud Rim: CMD, CME, CNF.	B	>60	>60	0-60	Loam and cobbly loam	CL	A-6	5-10
*Cluff: COF, CPC, CPD, CPF. For Daybell soil in COF, refer to Daybell series.	C	>60	40-60	0-14 14-36	Cobbly loam Very cobbly clay	CL-ML or CL CL	A-4 A-7	35-45 50-60
Crooked Creek: CrA, CrC	D	0-24	>60	0-70	Clay loam and silty clay	CL	A-7	---
Cudahy cold variant: Cv, Cw	D	0-36	12-36	0-26 26	Silt loam and silty clay loam Indurated lime pan.	ML	A-6 or A-4	---
*Daybell: DAF, DBE, DBF For Fitzgerald soil in DAF, refer to Fitzgerald series.	A	>60	>60	0-16 16-31 31-90	Loam and gravelly loam Gravelly loam and very gravelly loamy sand. Very gravelly sand	CL-ML or CL GM GP-GM	A-4 A-2 A-1	0-10 15-20 50-60

significant in engineering—Continued

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear more than; the symbol < means less than]

Percentage passing sieve [1]				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Potential frost action
No. 4 (4.76 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
70–80	65–75	60–70	50–65	30–40	5–10	0.2–0.6	0.05–0.08	6.6–7.8	Moderate	Moderate.
85–95	80–90	45–60	15–25	20–25	[4] NP	6.0–20.0	0.02–0.04	[3] 6.6–7.3	Low	Low.
50–60	30–45	25–35	15–25	20–25	NP–5	0.6–1.0	0.05–0.07	7.4–7.8	Low	Low.
95–100	90–100	75–85	60–70	30–35	10–15	0.2–0.6	0.07–0.1	6.6–7.3	Moderate	Moderate.
95–100	95–100	90–100	70–80	40–50	25–30	0.06–0.2	0.18–0.20	6.6–7.3	High	Moderate.
95–100	95–100	90–100	75–85	25–30	5–10	0.2–0.6	0.17–0.19	6.6–7.3	Low	Moderate.
45–55	30–45	25–35	15–25	25–30	5–10	0.6–2.0	0.05–0.08	5.1–6.0	Low	Moderate.
80–90	65–75	60–70	50–60	20–25	5–10	0.6–2.0	0.14–0.17	6.6–7.3	Low	Moderate.
65–75	55–65	40–50	30–40	20–25	5–10	2.0–6.0	0.08–0.1	6.6–7.8	Low	Moderate.
95–100	85–95	75–85	60–75	25–30	10–15	0.2–0.6	0.17–0.19	6.6–7.8	Low to moderate.	High.
30–40	20–30	15–25	10–20	25–30	5–10	2.0–6.0	0.05–0.08	7.4–7.8	Low	Moderate.
95–100	95–100	75–80	55–70	30–35	10–15	0.2–0.6	0.16–0.18	6.1–6.5	Moderate	Moderate.
75–85	70–80	30–50	20–30	20–25	5–10	2.0–6.0	0.06–0.08	6.1–7.3	Low	Moderate.
95–100	85–95	70–85	50–60	25–30	10–15	0.2–0.6	0.17–0.19	6.6–7.3	Low	Moderate.
90–95	85–90	75–85	60–70	25–30	5–10	0.6–2.0	0.17–0.19	6.6–7.8	Low	Moderate.
95–100	90–95	85–90	60–70	30–40	10–15	0.6–2.0	0.17–0.19	6.6–7.3	Moderate	Moderate.
85–90	75–85	65–75	50–60	20–25	5–10	0.6–2.0	0.06–0.08	5.1–6.0	Low	Moderate to high.
80–90	75–85	65–75	60–70	40–50	20–25	0.06–0.2	0.05–0.07	4.5–5.0	Moderate	Moderate.
95–100	95–100	95–100	75–85	40–45	20–25	<0.06	0.18–0.20	6.0–7.3	High	Moderate.
95–100	95–100	90–95	85–90	30–40	5–15	0.6–2.0	0.18–0.20	7.9–8.4	Moderate	High.
95–100	70–90	65–80	50–60	20–25	5–10	0.6–2.0	0.10–0.18	6.6–7.3	Moderate	Moderate.
55–60	50–55	45–50	20–30	15–20	0–5	6.0–2.0	0.05–0.07	6.6–7.3	Low	Low.
50–60	40–50	20–35	5–15	10–20	0–5	>20	0.01–0.03	6.6–7.3	Low	Low.

TABLE 7.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the first column. The symbol > means

Soil series and map symbols	Hydrologic group	Depth to—		Depth from surface	USDA texture	Soil classification		Coarse fragments more than 3 inches in diameter
		Water table	Bedrock			Unified	AASHO	
		Inches	*Inches*	*Inches*				*Percent*
*Deer Creek: DcA, DcC, DWC, DWD. For Watkins Ridge soil in DWC and DWD, refer to Watkins Ridge series.	C	>60	>60	0–14	Loam, gravelly clay loam	CL	A–6	0–5
				14–34	Gravelly clay	CL	A–7	15–20
				34–60	Gravelly and cobbly clay loam.	SC	A–6	10–20
Fluventic Haploborolls: FA. No estimates. Onsite investigation needed.								
Fitzgerald[2] Mapped only in unit DAF under Daybell.	B	>60	>48	0–26	Gravelly loam and gravelly sandy loam.	SM or GM	A–4 or A–2	5–10
				26–54	Very gravelly loam or sandy clay loam.	GM	A–1	10–15
*Flygare: FBB, FBC, FBD, FLD, FLE, FRE, FRF. For Little Pole soils in FLD and FLE, refer to Little Pole series.	B	>60	>48	0–17	Loam, cobbly loam	CL-ML or CL	A–4	0–30
				17–36	Very cobbly loam	CL-ML or CL	A–4	50–70
				36–70	Cobbly or very cobbly sandy loam.	SC or GC	A–2 or A–4	20–50
Flygare variant: FSE	A	>60	>60	0–85	Coarse sandy loam and cobbly coarse sandy loam.	SC-SM or SC	A–4 or A–2	5–35
*Gappmayer: GAD, GAF, GMF, GPF, GWF. For Bradshaw soil in GPF, refer to Bradshaw series; for Wallsburg soil in GWF, refer to Wallsburg series.	B	>60	40–50	0–28	Gravelly or cobbly fine sandy loam.	SC-SM or SC	A–4	10–15
				28–44	Very cobbly sandy clay loam.	GC	A–2	20–50
Hailman: HAC, HAD, HBF	B	>60	>60	0–57	Loam, cobbly loam	CL-ML or CL	A–4	0–30
*Henefer: HeA, HeC, HeD, HFF, HGF, HHF, HJC, HJD, HJE. For Bradshaw soil in HFF, refer to Bradshaw series; for Gappmayer soil in HGF, refer to Gappmayer series.	C	>60	>60	0–12	Silt loam, cobbly silt loam	CL-ML or CL	A–4	0–30
				12–60	Cobbly clay and very cobbly clay.	CL	A–7	20–45
Holmes: Hk, Hm, Ho, Hr	B	>60	>60	0–21	Cobbly gravelly or very gravelly loam.	GM-GC or GC	A–4 or A–2	5–15
				21–60	Very gravelly loamy sand	GP-GM	A–1	15–20
*Horrocks: HWC, HWE, HWF. For Broadhead soil in HWC, HWE, and HWF, refer to Broadhead series.	B	>40	>40	0–41	Very cobbly sandy clay loam or sandy loam.	SC	A–2	30–35
Kovich: Kc, Kd, Kh	C	12–36	>60	0–29	Loam	CL	A–6	
				29–60	Very cobbly sandy clay loam.	GC-GM or GC	A–2	10–25
Kovich deep water table variant: Km.	C	36–48	>60	0–60	Loam	CL	A–6	0–10
Kovich gravelly subsoil variant: Kp, Kr, Ks.	D	12–24	>60	0–14	Loam	CL	A–6	
				14–21	Very fine sandy clay loam	SC	A–6	0–5
				21–60	Very cobbly loamy coarse sand.	GP-GM	A–1	20–30

significant in engineering—Continued

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear more than; the symbol < means less than]

Percentage passing sieve [1]				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Potential frost action
No. 4 (4.76 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
				Percent		*In per hr*	*In per in.*	*pH*		
80–90	65–80	55–75	50–60	30–35	10–15	0.6–2.0	0.15–0.17	6.6–7.3	Moderate	Moderate.
80–90	75–85	70–75	60–70	40–50	25–30	0.06–0.2	0.08–0.10	6.1–6.5	High	Moderate.
75–85	70–80	60–70	40–50	35–40	10–15	0.6–2.0	0.11–0.13	7.4–7.8	Moderate	Moderate.
70–75	50–60	45–55	20–40	30–35	5–10	0.6–2.0	0.08–0.10	[3] 6.1–6.5	Moderate	Moderate.
25–35	20–30	15–25	10–20	20–25	0–5	2.0–6.0	0.04–0.06	[3] 6.1–6.5	Low	Low.
90–100	80–95	70–80	50–60	25–30	5–10	0.6–2.0	0.15–0.17	5.6–6.5	Moderate	Moderate.
85–95	80–90	70–80	50–60	25–30	5–10	0.6–2.0	0.04–0.06	5.6–6.0	Moderate	Moderate.
65–75	60–70	45–55	25–40	25–30	5–10	0.6–2.0	0.10–0.12	5.6–6.0	Moderate	Moderate.
80–90	75–85	40–60	25–45	20–25	5–10	2.0–6.0	0.07–0.09	5.6–6.5	Low	Moderate.
75–85	70–80	60–70	35–45	20–25	5–10	0.6–2.0	0.07–0.09	6.6–7.3	Low	Moderate.
50–60	40–50	35–45	20–30	30–35	10–15	0.2–0.6	0.10–0.12	6.1–6.5	Moderate to high.	Moderate.
80–90	70–85	60–70	50–60	25–30	5–10	0.6–2.0	0.09–0.10	5.6–6.0	Low to moderate.	Moderate.
90–100	85–95	80–90	75–85	25–30	5–10	0.2–0.6	0.18–0.20	6.1–7.3	Low to moderate.	Moderate.
90–100	85–95	85–90	75–85	40–50	25–30	0.06–0.2	0.08–0.10	5.6–6.5	Moderate to high.	Moderate to high.
60–70	50–60	35–50	30–40	25–30	5–10	0.6–2.0	0.09–0.12	6.6–7.3	Moderate to low.	Moderate.
35–50	20–30	15–25	5–10	20–25	0–5	6.0–20	0.02–0.03	6.6–7.3	Low	Low.
70–80	65–75	50–55	25–35	30–35	10–15	0.6–2.0	0.04–0.07	6.1–7.3	Moderate	Moderate.
90–100	85–95	80–90	60–70	30–35	10–15	0.6–2.0	0.16–0.19	6.1–6.5	Moderate	High.
50–60	40–50	30–40	20–30	20–25	5–10	2.0–6.0	0.03–0.05	6.6–7.3	Low	Low to moderate.
90–100	85–95	80–90	65–80	30–35	10–15	0.6–2.0	0.16–0.19	6.6–7.8	Moderate	High.
90–100	85–95	80–90	60–70	25–30	10–15	0.6–2.0	0.16–0.19	[3] 7.4–7.8	Moderate	High.
85–95	70–80	60–70	35–45	25–30	10–15	0.6–2.0	0.10–0.12	6.6–7.3	Low	Moderate.
45–50	40–45	15–20	5–10	15–20	0–5	6.0–20	0.03–0.05	[3] 6.6–7.3	Low	Low.

TABLE 7.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the first column. The symbol > means

Soil series and map symbols	Hydrologic group	Depth to—		Depth from surface	USDA texture	Soil classification		Coarse fragments more than 3 inches in diameter
		Water table	Bedrock			Unified	AASHO	
Lake Janee: LAE	A	>60	>60	0–66	Sandy loam, cobbly sandy loam.	SC-SM or SC	A–2	10–40
Little Pole: LPD, LPF	D	>60	12–24	0–16	Very cobbly sandy clay loam.	CL	A–6	40–65
				16	Andesite bedrock.			
Logan variant: Lr	C	12–24	>60	0–16	Silty clay	CL	A–7	----------
				16–29	Loam	CL	A–6	----------
				29–60	Gravelly loam, very gravelly loamy sand.	GM or GP-GM	A–1	10–20
Manila: MaB, MaC, MaD	C	>60	>60	0–26	Silt loam, silty clay loam	CL-ML or CL	A–4	----------
				26–97	Silty clay	CL	A–7	----------
*McPhie: MCF, MHF For Henefer soil in MHF, refer to Henefer series.	B	>60	>60	0–64	Fine sandy loam, cobbly sandy loam.	SC-SM, GC-GM, SC, or GC	A–2	20–30
				64–78	Very cobbly loamy sand	GM	A–1	20–30
Mult variant: MRE, MSD	B	>60	>60	0–32	Loam, clay loam	CL	A–6	0–10
				32–70	Gravelly sandy loam	GC	A–2	0–10
Poleline: POF	B	>60	>60	0–44	Gravelly and very gravelly loam.	SC-SM, GC-GM, SC, or GC	A–2	0–20
				44–60	Loamy sand	SM	A–2	0–5
Rasband: RaB, RCC, RdA, RdC.	B	>60	>60	0–30	Sandy loam, loam	CL-ML or CL	A–4	0–5
				30–60	Gravelly, very gravelly, or cobbly loamy sand.	SM	A–1	5–10
Rock land: RO, Rp. No estimates.								
*Roundy: RRC, RRD, RRE, RRF, RSC, RSD, RUF, RYD. For Cluff soils in RSC and RSD, refer to Cluff series; for Daybell soil in RUF, refer to Daybell series.	C	>40	>40	0–16	Loam and cobbly loam	ML	A–4	10–25
				16–31	Very cobbly fine sandy loam.	ML	A–4	50–60
				31–48	Cobbly clay	CH	A–7	20–30
Sessions: SEC, SED	C	>60	>60	0–13	Clay loam	CL	A–6	0–10
				13–61	Clay and cobbly clay	CL	A–7	20–25
Spaa: SpB	D	>60	6–20	0–17	Silt loam	CL	A–6	0–5
				17	Travertine.			
Steed variant: St, Sv	B	>60	>60	0–12	Loam and cobbly loam	SC	A–4	10–50
				12–60	Very gravelly loamy sand	GP	A–1	10–20
*Van Wagoner: VMF, VWF For McPhie soil in VMF, refer to McPhie series. No interpretations for Rock outcrop in VWF.	D	>60	12–20	0–20	Cobbly sandy loam	SM	A–2 or A–4	20–50
				20	Quartz diorite porphyry bedrock.			
Wallsburg: WBF	D	>60	12–20	0–12	Very cobbly sandy clay loam or clay loam.	ML or CL or SC or SM	A–6	40–60
				12	Sandstone bedrock.			

significant in engineering—Continued

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear more than; the symbol < means less than]

Percentage passing sieve [1]				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Potential frost action
No. 4 (4.76 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
75–85	70–80	40–60	25–35	20–25	5–10	0.6–2.0	0.05–0.10	5.6–6.0	Low	Moderate.
90–95	80–90	65–75	50–60	30–40	10–15	0.6–2.0	0.07–0.10	6.6–7.3	Moderate	Moderate.
100	95–100	90–100	85–95	40–50	25–30	0.06–0.2	0.19–0.21	7.4–7.8	High	High.
100	90–100	85–95	65–75	30–35	10–15	0.2–0.6	0.17–0.20	7.4–7.8	Moderate	High.
40–50	35–45	20–30	5–10	15–20	0–5	>20	0.03–0.05	7.4–8.4	Low	Low.
----------	100	90–100	80–90	25–30	5–10	0.6–2.0	0.18–0.20	[3] 6.6–7.3	Moderate	Moderate.
----------	100	90–100	85–95	40–50	25–30	0.06–0.2	0.18–0.20	[3] 6.6–7.3	High	Moderate to high.
70–80	60–70	40–50	25–35	20–25	5–10	0.6–2.0	0.10–0.12	5–6–6.5	Low	Moderate.
50–60	40–50	25–35	10–20	15–20	0–5	2.0–6.0	0.01–0.03	6.1–6.5	Low	Low.
80–95	75–85	70–80	50–60	30–35	10–15	0.6–2.0	0.17–0.19	5.6–6.5	Moderate	High.
50–60	40–50	30–40	15–25	20–25	5–10	0.6–2.0	0.08–0.10	6.6–7.3	Low	Moderate.
60–70	45–55	40–45	25–35	25–30	5–10	0.6–2.0	0.08–0.10	6.1–6.5	Low	Moderate.
80–90	75–85	45–60	20–30	15–20	0–5	2.0–6.0	0.08–0.10	6.6–7.3	Low	Moderate.
80–90	75–85	65–75	50–60	25–30	5–10	0.6–2.0	0.13–0.15	6.1–7.3	Low	Moderate.
60–70	40–60	30–40	15–25	15–20	0–5	2.0–6.0	0.07–0.09	6.6–7.3	Low	Low to moderate.
90–100	85–95	80–90	65–75	20–25	0–5	0.6–2.0	0.12–0.15	6.1–6.5	Low	Moderate.
80–90	75–85	70–80	60–70	15–20	0–5	0.6–2.0	0.04–0.06	6.1–6.5	Low	Moderate.
100	95–100	85–95	75–85	55–70	35–45	0.06–0.2	0.13–0.16	5.1–5.3	High	Moderate.
90–100	75–85	65–75	55–65	35–40	10–15	0.2–0.6	0.15–0.17	6.6–7.3	Moderate	Moderate.
80–90	65–75	60–70	50–60	40–50	15–20	0.06–0.2	0.13–0.15	6.1–7.8	High	Moderate to high.
100	95–100	85–95	80–90	30–35	10–15	0.6–2.0	0.15–0.17	[3] 7.9–8.4	Low to moderate.	High.
80–90	75–85	50–60	35–45	25–30	5–10	2.0–6.0	0.08–0.12	[3] 7.4–7.8	Low	Moderate.
30–40	20–30	10–20	0–5	--------	NP	6.0–20	0.01–0.03	[3] 7.4–7.8	Low	Low.
90–100	80–90	60–70	30–40	20–25	0–5	2.0–6.0	0.06–0.08	6.6–7.3	Low	Moderate to high.
75–85	60–80	55–75	35–60	35–40	10–15	0.2–0.6	0.08–0.10	6.6–7.3	Moderate	Moderate.

TABLE 7.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the first column. The symbol > means

Soil series and map symbols	Hydrologic group	Depth to—		Depth from surface	USDA texture	Soil classification		Coarse fragments more than 3 inches in diameter
		Water table	Bedrock			Unified	AASHO	
*Watkins Ridge: WcC, WcD, WLC, WLD, WNC, WND. For Clegg soils in WLC and WLD, refer to Clegg series; for Deer Creek soils in WNC and WND, refer to Deer Creek series.	B	>60	>60	0–60	Loam, silt loam, clay loam, or cobbly silt loam.	CL	A–6	5–10
Whipstock: WPF, WSC, WSD, WSE.	C	>60	>60	0–21	Cobbly or very cobbly loam or clay loam.	CL	A–6	15–60
				21–59	Cobbly clay	CH	A–7	20–30
				59–69	Very cobbly clay loam or clay.	CH	A–7	50–60
*Yeates Hollow:[2] YaB, YEC, YED, YTC, YTD. For Henefer soil in YTC and YTD, refer to Henefer series.	C	>60	>60	0–12	Very cobbly loam or clay loam.	CL-ML or CL	A–4	10–60
				12–60	Cobbly and very cobbly clay.	CH	A–7	50–70

[1] Refer to table 10 for more detailed analyses.
[2] No laboratory data available.

TABLE 8.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the

Soil series and map symbols	Suitability as a source of—			Degree and kind of limitation for—		
	Topsoil	Road fill	Sand and gravel	Foundations for dwellings [1]	Septic tank absorption field	Sanitary landfill, trench type
*Agassiz: AGF, AWF. For the Wallsburg soil in AWF, refer to Wallsburg series.	Unsuitable: shallow over bedrock; very cobbly; steep.	Unsuitable: shallow over bedrock; very cobbly; steep.	Unsuitable: shallow over bedrock; very cobbly; mostly SC material.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.
*Baird Hollow: BAC, BAD, BAE, BAF, BCC, BCE, BDC. For Flygare soil in BCC and BCE, refer to Flygare series; for BDC, refer to Flygare variant.	Fair for BAC, poor for all other units: strongly sloping to steep.	Poor: moderate potential frost action; moderate shrink-swell; mostly A–6 or A–7 material; slope 6 to 60 percent.	Unsuitable: excessive fines.	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action; moderate bearing strength.	Severe: slow permeability; steep.	Severe: clayey; stony; rocky.
Bezzant: BeD2, BfC, BGE.	Poor: cobbly and very cobbly.	Fair: moderate potential frost action; cobbly or very cobbly; slope 6 to 45 percent.	Unsuitable: mostly ML material; excessive fines.	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action; moderate bearing strength.	Severe: moderately slow permeability.	Severe: very cobbly.

significant in engineering—Continued

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear more than; the symbol < means less than]

Percentage passing sieve [1]				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Potential frost action
No. 4 (4.76 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
100	90–100	80–90	60–70	30–35	10–15	0.2–0.6	0.16–0.18	7.4–7.8	Low	Moderate.
80–90	75–85	65–80	60–70	30–35	10–15	0.2–0.6	0.10–0.13	6.1–7.3	Moderate	Moderate.
95–100	90–95	85–90	80–85	>70	45–55	0.06–0.2	0.14–0.18	6.1–7.3	High	Moderate.
85–95	75–85	70–80	60–70	50–55	25–30	0.06–0.2	0.06–0.09	7.4–7.8	High	Moderate.
85–95	80–90	65–80	60–70	25–30	5–10	0.2–0.6	0.06–0.14	[3] 6.6–7.3	Moderate to low.	Moderate.
95–100	85–95	80–90	70–80	>70	40–45	0.06–0.2	0.06–0.08	[3] 6.1–6.5	Moderate to high.	Moderate to high.

[3] Reaction pH 1.5.
[4] Nonplastic.

interpretations

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear first column]

Degree and kind of limitation for—			Soil features affecting—			
Sewage lagoons	Local roads and streets	Shallow excavations	Pond reservoirs	Embankments	Agricultural drainage	Irrigation
Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Shallow over bedrock; steep.	Limited quantity; steep.	Not applicable	Not applicable.
Severe if slope is more than 7 percent, moderate if less than 7: slow permeability in upper 29 inches.	Severe: moderate potential frost action; moderate shrink-swell; slope more than 15 percent; mostly A-6 or A-7 material.	Severe: clay texture; usually steep; cobbly.	Steep in places	Cobby; medium compressibility; low shear strength.	Not applicable	Not applicable.
Severe if slope is more than 7 percent, moderate if less than 7.	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action; cobbly or very cobbly; A-4 material.	Severe if slope is more than 15 percent, moderate if less than 15.	Very cobbly; steep in places.	Cobbly; medium shear strength; compressibility; high susceptibility to piping.	Not applicable	Not applicable.

TABLE 8.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the

Soil series and map symbols	Suitability as a source of—			Degree and kind of limitation for—		
	Topsoil	Road fill	Sand and gravel	Foundations for dwellings [1]	Septic tank absorption field	Sanitary landfill, trench type
Brad: BHF No interpretations for Rock outcrop.	Unsuitable: shallow over bedrock; steep; very cobbly.	Unsuitable: shallow over bedrock; very cobbly; steep.	Unsuitable: shallow over bedrock; very cobbly; excessive fines.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.
*Bradshaw: BKF, BLF, BMF. For Henefer soil in BLF, refer to Henefer series; for Wallsburg soil in BMF, refer to Wallsburg series.	Unsuitable: very cobbly; steep.	Poor: steep; high in content of coarse fragments.	Unsuitable for sand, poor for gravel: mostly GM material; excessive fines.	Severe: steep	Severe: steep	Severe: steep; rapid permeability.
*Broadhead: BOE, BPC, BPD, BPE, BPF, BTC, BTD, BTE, BTF. For Little Pole soil in BPC, BPD, BPE, BPF, refer to Little Pole series.	Fair if slope is less than 15 percent and not cobbly, poor if more than 15 and cobbly.	Poor: moderate potential frost action; high shrink-swell; mostly A–6 or A–7 material; slope 6 to 60 percent.	Unsuitable: mostly CL material; excessive fines.	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action; moderate shrink-swell.	Severe: slow permeability.	Severe: clayey
Buell: BVC, BVD, BVF	Poor: coarse fragments.	Good if slope is less than 15 percent, fair if 15 to 25, poor if more than 25.	Poor: mostly SM or GM material; excessive fines.	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action.	Severe if slope is more than 15 percent, moderate if 8 to 15, slight if less than 8.	Severe if slope is more than 25 percent, moderate if 15 to 25, slight if less than 15.
*Burgi: BWE, BWF, BXF, BYF. For Agassiz soil in BXF, refer to Agassiz series; for Wallsburg soil in BYF, refer to Wallsburg series.	Poor: steep	Poor: moderate potential frost action; steep.	Unsuitable for gravel, poor below a depth of 12 inches for sand; excessive fines.	Severe: steep; moderate potential frost action.	Severe: steep	Severe: steep
Center Creek: Ca	Good	Poor in top 33 inches: high potential frost action; A–6 material. Good below a depth of 33 inches if drained: A–2 material.	Unsuitable	Severe: high potential frost action; seasonal water table at a depth of 36 to 60 inches.	Severe: water table above a depth of 48 inches.	Severe: seasonal water table above a depth of 48 inches.
*Clayburn: CBB, CBC, CBD, CCD, CDE. For Flygare soil in CCD, refer to Flygare series.	Good if not cobbly and slope is less than 8 percent, fair if 8 to 15, poor if more than 15.	Poor in top 41 inches: A–6 material. Good below a depth of 41 inches: moderate potential frost action; A–2 material; slope is 3 to 40 percent.	Unsuitable	Severe if slope is more than 15 percent, moderate if less than 15: moderate bearing strength.	Severe if slope is more than 15 percent, moderate if 8 to 15: permeability and bedrock a problem in places.	Severe if slope is more than 25 percent, moderate if less than 25: bedrock a problem in places.

interpretations—Continued

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear first column]

Degree and kind of limitation for—			Soil features affecting—			
Sewage lagoons	Local roads and streets	Shallow excavations	Pond reservoirs	Embankments	Agricultural drainage	Irrigation
Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Steep	High susceptibility to piping; limited quantity.	Not applicable	Not applicable.
Severe: steep; permeability greater than 2 inches per hour.	Severe: steep; cobbly.	Severe: steep; high in content of coarse fragments.	Steep: excessive permeability.	Cobbly; medium permeability.	Not applicable	Not applicable.
Severe if slope is more than 7 percent, moderate if less than 7.	Severe: slope is more than 15 percent; A–6 or A–7 material; high shrink-swell below a depth of 12 inches; moderate potential frost action.	Severe: clayey; steep in most places.	Steep in places	Medium compressibility; low shear strength; high susceptibility to piping.	Not needed	May irrigate BTC and BTD if used for forage crops and intensive water control practices.
Severe if slope is more than 7 percent, moderate if less than 7.	Moderate if slope is 8 to 15 percent, severe if more than 25.	Severe: high in coarse fragments.	Steep in places	Medium compacted permebility.	Not applicable	Not applicable.
Severe: steep	Severe: slope more than 15 percent; moderate potential frost action.	Severe: high in coarse fragments.	Steep	Medium shear strength; medium compacted permeability; medium susceptibility to piping.	Not applicable	Not applicable.
Severe: seasonal water table. Moderate where water table is 40 to 60 inches below surface.	Severe: water table above a depth of 48 inches; high potential frost action in top 33 inches; A–6 material.	Moderate: seasonal water table.	Favorable if not excavated.	Shear strength low above a depth of 33 inches; medium permeability below a depth of 33 inches.	Seasonal high water table; can be drained if outlets are available.	Undulating topography in some places; needs careful control.
Severe if slope is more than 7 percent, moderate if less than 7 in CBB and CBC.	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action.	Severe if slope is more than 15 percent, moderate if 8 to 15, slight if less than 8.	Steep in places	Low shear strength above a depth of 41 inches; medium susceptibility to piping.	Not applicable	Not applicable.

TABLE 8.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the

Soil series and map symbols	Suitability as a source of—			Degree and kind of limitation for—		
	Topsoil	Road fill	Sand and gravel	Foundations for dwellings [1]	Septic tank absorption field	Sanitary landfill, trench type
Clegg: CgA, CgB, CgC, ChC.	Good if not cobbly and slope is less than 8 percent.	Poor in top 21 inches: A–6 material. Fair below a depth of 21 inches: A–4 material; moderate potential frost action.	Unsuitable	Moderate: moderate potential frost action; moderate bearing strength.	Severe if slope is more than 15 percent, moderate if less than 15: moderate permeability; bedrock a problem in places.	Severe if slope is more than 25 percent, moderate if 15 to 25, slight if less than 15: bedrock may be a problem.
Cloud Rim: CMD, CME, CNF.	Fair if slope is less than 8 percent, poor if more than 8.	Poor: A–6 material; moderate shrink-swell; moderate potential frost action; slope 6 to 60 percent.	Unsuitable	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action; moderate bearing strength.	Severe if slope is more than 15 percent, moderate if less than 15: permeability.	Severe if slope is more than 25 percent, moderate if 15 to 25.
*Cluff: COF, CPC, CPD, CPF. For Daybell soil in COF, refer to Daybell series.	Poor: cobbly; low in content of organic matter.	Poor: cobbly or very cobbly below a depth of 14 inches; A–7 material; moderate shrink-swell; moderate potential frost action; slope 6 to 60 percent.	Unsuitable: mostly CL material.	Severe: slope is 6 to 60 percent; moderate potential frost action; low bearing strength.	Severe: slow permeability; bedrock a problem in places.	Severe: very cobbly clay; bedrock a problem in places.
Crooked Creek: CrA, CrC.	Fair: fine texture.	Poor: high shrink-swell; A–7 material; moderate potential frost action.	Unsuitable: mostly CL material.	Severe: high shrink-swell potential; high seasonal water table; moderate bearing strength; moderate potential frost action.	Severe: very slow permeability; high seasonal water table.	Severe: seasonal water table above a depth of 72 inches; clayey.
Cudahy variant: Cv, Cw	Poor: high water table; high in content of lime.	Poor: high potential frost action; high water table; shallow over indurated lime pan.	Unsuitable: mostly ML or CL material; lacks thickness.	Severe: high water table; high potential frost action.	Severe: high water table; limited depth to hardpan.	Severe: high water table; shallow to hardpan.
*Daybell: DAF, DBE, DBF. For Fitzgerald soil in DAF, refer to Fitzgerald series.	Poor: steep	Poor: steep	Fair below a depth of 16 inches for gravel, poor below a depth of 16 inches for sand: excessive fines.	Severe: steep; moderate potential frost action in top 16 inches.	Severe: steep	Severe: steep; very rapid permeability.

interpretations—Continued

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear first column]

Degree and kind of limitation for—			Soil features affecting—			
Sewage lagoons	Local roads and streets	Shallow excavations	Pond reservoirs	Embankments	Agricultural drainage	Irrigation
Severe if slope is more than 7 percent, moderate if 2 to 7 in CgB and CgC, slight if less than 2 in CgA.	Severe: moderate potential frost action; mostly A–6 material; cobbly; slope 1 to 15 percent.	Severe if slope is 15 percent, moderate if 8 to 15.	Steep in places; bedrock a problem for excavated ponds in places.	Low shear strength; fair compaction; cobbly; medium to high susceptibility to piping.	Not applicable	Not applicable.
Severe: steep	Severe: moderate potential frost action; A–6 material; steep.	Severe if slope is more than 15 percent, moderate if 8 to 15.	Steep in places	Low to medium shear strength.	Not applicable	Not applicable.
Severe: slope is more than 7 percent; cobbly.	Severe: slope is more than 15 percent; cobbly and stony; mostly A–7 material; moderate potential frost action; moderate shrink swell.	Severe: clayey; high in content of coarse fragments; steep in most places.	Steep in places; bedrock a problem for excavated ponds in places.	Very cobbly; low to medium shear strength.	Not applicable	Not applicable.
Severe: seasonal high water table.	Severe: seasonal high water table; high shrink-swell; mostly A–7 material; moderate potential frost action.	Severe: clayey; seasonal high water table.	Favorable	Low shear strength; fair to poor compaction.	Very slowly permeable; seasonal high water table.	Very slow intake; fine texture.
Severe: high water table.	Severe: high water table; shallow to hardpan; high potential frost action.	Severe: high water table; indurated hardpan at a depth of 20 to 36 inches.	Shallow depth to hardpan; high water table limits excavation.	Medium to high susceptibility to piping; low shear strength; fair compaction; limited depth of material.	Drainage very difficult because of artesian pressure; travertine bedrock at a depth of 24 inches.	High water table; soil about 24 inches thick.
Severe: steep; permeability more than 2 inches per hour.	Severe: steep; cobbly or very cobbly.	Steep; high in content of coarse fragments.	Steep; high permeability.	High permeability; low in fines below a depth of 16 inches.	Not applicable	Not applicable.

TABLE 8.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the

Soil series and map symbols	Suitability as a source of—			Degree and kind of limitation for—		
	Topsoil	Road fill	Sand and gravel	Foundations for dwellings [1]	Septic tank absorption field	Sanitary landfill, trench type
*Deer Creek: DcA, DcC, DWC, DWD. For Watkins Ridge soil in DWC and DWD, refer to Watkins Ridge series.	Good if not cobbly and slope is less than 8 percent, fair if 8 to 15.	Poor: high shrink-swell; mostly A-6 or A-7 material; moderate potential frost action.	Unsuitable	Severe: high shrink-swell below a depth of 14 inches; slope 1 to 25 percent; moderate potential frost action; low bearing strength.	Severe if slope is more than 15 percent: slow permeability to a depth of 34 inches. Moderate if slope is 8 to 15 percent: permeability below a depth of 34 inches is moderate.	Severe: clayey; cobbly.
Fitzgerald Mapped only in DAF under Daybell.	Poor: gravelly; low in content of organic matter; steep.	Poor: steep	Unsuitable above a depth of 26 inches, poor below a depth of 26 inches: excessive fines.	Severe: steep; moderate potential frost action in top 26 inches.	Severe: steep	Severe: steep
Fluventic Haploborolls: FA. No interpretations. Material too variable.						
*Flygare: FBB, FBC, FBD, FLD, FLE, FRE, FRF. For Little Pole soil in FLD and FLE, refer to Little Pole series.	Good if not cobbly and slope is less than 8 percent, fair if 8 to 15, poor if more than 15.	Poor if slope is more than 25 percent; high organic content. Fair if slope is less than 25 percent: moderate potential frost action; A-4 material.	Unsuitable	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action; moderate bearing strength.	Severe if slope is more than 15 percent, moderate if less than 15: bedrock a problem in places.	Severe if slope is more than 25 percent, moderate if 15 to 25: bedrock a problem in places.
Flygare variant: FSE	Fair if slope is less than 15 percent, poor if more than 15: erodible.	Poor: steep; moderate potential frost action.	Unsuitable	Severe if slope is more than 16 percent: potential frost action.	Severe if slope is more than 15 percent, moderate if 8 to 15: bedrock a problem in places.	Severe: steep; bedrock a problem in places.
*Gappmayer: GAD, GAF, GMF, GPF, GWF. For Bradshaw soil in GPF, refer to Bradshaw series; for Wallsburg soil in GWF, refer to Wallsburg series.	Fair if slope is less than 15 percent, poor if more than 15: gravelly.	Poor if slope is more than 25 percent, fair if less than 25: top 28 inches mostly A-4 material, below a depth of 28 inches A-2 material.	Unsuitable above a depth of 28 inches, poor below a depth of 28 inches: excessive fines.	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action; moderate bearing strength above a depth of 24 inches.	Severe if slope is more than 15 percent: moderately slow permeability; bedrock a problem in places.	Severe if slope is more than 25 percent, moderate if 15 to 25: coarse fragments; bedrock a problem in places.

interpretations—Continued

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear first column]

Degree and kind of limitation for—			Soil features affecting—			
Sewage lagoons	Local roads and streets	Shallow excavations	Pond reservoirs	Embankments	Agricultural drainage	Irrigation
Severe if slope is more than 7 percent, moderate if 2 to 7 in DcC, slight if less than 2 in DcA.	Severe: slope more than 15 percent; moderate potential frost action; high shrink-swell; mostly A–6 or A–7 material; cobbly.	Severe: clayey	Favorable	Low shear strength; high compressibility.	Not needed	May irrigate.
Severe: steep; permeability more than 2 inches per hour.	Severe: steep	Severe: steep; high in content of coarse fragments.	Medium to high permeability; steep.	Lacks fines below a depth of 26 inches; medium to high permeability; steep.	Not applicable	Not applicable.
Severe if slope is more than 7 percent, moderate if less than 7 in FBB and FBC.	Severe if slope is more than 15 percent: high content of organic matter in upper 3 feet. Moderate if slope is 8 to 15 percent: moderate potential frost action; mostly A–4 material.	Severe: high in content of coarse fragments; steep in most places.	Steep in places; bedrock a problem for excavated ponds in places; medium permeability.	High in content of organic matter in top 36 inches; very cobbly and medium permeability at a depth below 36 inches.	Not applicable	Not applicable.
	Severe: slope more than 15 percent; moderate potential frost action; erodible; cobbly.	Severe: high in content of coarse fragments; steep.	Steep in places; bedrock a problem for excavated ponds in places.	Compaction fair; cobbly; medium permeability; medium susceptibility to piping.	Not applicable	Not applicable.
Severe: steep	Severe if slope is more than 15 percent, moderate if less than 15 percent: moderate potential frost action and A–4 material above a depth of 28 inches; cobbly.	Severe: high in content of coarse fragments; steep.	Medium permeability; steep.	Cobbly, gravelly; medium permeability.	Not applicable	Not applicable.

TABLE 8.—*Engineering*

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Soil series and map symbols	Suitability as a source of—			Degree and kind of limitation for—		
	Topsoil	Road fill	Sand and gravel	Foundations for dwellings [1]	Septic tank absorption field	Sanitary landfill, trench type
Hailman: HAC, HAD, HBF.	Good if not cobbly and slope is less than 8 percent, fair if 8 to 15, poor if more than 15.	Poor if slope is more than 25 percent, fair if less than 25: A-4 material; moderate potential frost action.	Unsuitable	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action; moderate bearing strength.	Severe if slope is more than 15 percent, moderate if less than 15: moderate permeability; bedrock a problem in places.	Severe if slope is more than 25 percent, moderate if 15 to 25, slight if less than 15: bedrock a problem in places.
*Henefer: HeA, HeC, HeD, HFF, HGF, HHF, HJC, HJD, HJE. For Bradshaw soil in HFF, refer to Bradshaw series; for Gappmayer soil in HGF, refer to Gappmayer series; for Wallsburg soil in HHF, refer to Wallsburg series.	Good if not cobbly and slope is less than 8 percent, fair if 8 to 15, poor if more than 15.	Poor: high potential frost action; high shrink-swell; mostly A-7 material.	Unsuitable	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action; moderate bearing strength.	Severe: slow permeability; bedrock a problem in places.	Severe: very cobbly and clayey; bedrock a problem in places.
Holmes: Hk, Hm, Ho, Hr.	Fair to a depth of 21 inches and high amount of gravel and cobbles, unsuitable below a depth of 21 inches.	Good: mostly A-1 material; cobbly in places.	Unsuitable to a depth of 21 inches; fair below a depth of 21 inches.	Moderate in top 21 inches: moderate potential frost action; moderate bearing strength. Slight below a depth of 21 inches.	Slight: local pollution into reservoirs or streams in places.	Severe: rapid permeability; very gravelly.
*Horrocks: HWC, HWE, HWF. For Broadhead soil in HWC, HWE, and HWF, refer to Broadhead series.	Poor: very cobbly.	Good if slope is less than 15 percent, fair if 15 to 25, poor if more than 25.	Unsuitable	Severe if slope is more than 15 percent, moderate if less than 15: moderate potential frost action.	Severe if slope is more than 15 percent; moderate if less than 15: moderate permeability; bedrock a problem in places.	Severe: very cobbly. Also severe if slope is more than 25 percent, but moderate if less than 25: bedrock a problem in. places.
Kovich: Kc, Kd, Kh	Poor: high water table.	Poor: high water table; high potential frost action; mostly A-6 material.	Unsuitable	Severe: high water table; high potential frost action; moderate bearing strength in top 29 inches.	Severe: high water table.	Severe: high water table; rapid permeability; very gravelly.
Kovich deep water table variant: Km.	Good, but gravelly areas in places.	Poor: water table at a depth of 3 to 4 feet; high potential frost action; mostly A-6 material.	Unsuitable	Severe: high potential frost action; water table at a depth of 3 to 4 feet; moderate bearing strength.	Severe: water table at a depth of 3 to 4 feet.	Severe: water table at a depth of 3 to 4 feet.

interpretations—Continued

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear first column]

Degree and kind of limitation for—			Soil features affecting—			
Sewage lagoons	Local roads and streets	Shallow excavations	Pond reservoirs	Embankments	Agricultural drainage	Irrigation
Severe if slope is more than 7 percent, moderate if less than 7 in HAC.	Severe if slope is more than 15 percent, moderate if 8 to 15: mostly A–4 material; cobbly; moderate potential frost action.	Severe if slope is more than 15 percent, moderate if 8 to 15 percent.	Steep in places; slope; bedrock a problem for excavated ponds in places.	Low shear strength; fair compaction; cobbly; medium to high susceptibility to piping.	Not applicable	Not applicable.
Severe if slope is more than 7 percent, moderate if 2 to 6 in HeC, slight if less than 2 in HeA.	Severe: slope more than 15 percent; cobbly; high shrink swell; mostly A–7 material below a depth of 12 inches; moderate potential frost action.	Severe: clayey; steep in most places.	Steep in places; bedrock a problem for excavated ponds in places.	Low shear strength; fair compaction; cobbly or very cobbly.	Not needed	May irrigate HeA, HeC, HeD with good water control.
Severe: permeability more than 2 inches.	Moderate: moderate potential frost action to a depth of 21 inches, slight below a depth of 21 inches; mostly A–1 material.	Severe: high in content of coarse fragments.	High permeability	Highly permeable below a depth of 21 inches and high in content of coarse fragments.	Not needed	Low water-holding capacity; shallow root zone; cobbly in places.
Severe: steep	Severe if slope is more than 15 percent, moderate if 8 to 15: moderate potential frost action; cobbly.	Severe: steep, high in content of coarse fragments.	Steep in places; bedrock a problem for excavated ponds in places.	Very cobbly	Not applicable	Not applicable.
Severe: high water table; high potential frost action.	Severe: high water table; high potential frost action in upper 29 inches.	Severe: high water table.	High water table a problem for excavated ponds in places.	Low shear strength and medium compaction above a depth of 29 inches; very cobbly below a depth of 29 inches.	High water table; outlets limited in some places.	Needs drainage; undulating topography in some places; needs careful control.
Moderate: water table at a depth of 3 to 4 feet.	Severe: high potential frost action; water table at a depth of 3 to 4 feet.	Moderate: water table at a depth of 3 to 4 feet.	Water table a problem for excavated ponds in places.	Low shear strength; poor compaction; medium compressibility.	Water table at a depth of 3 to 4 feet; some outlet limitation.	Needs careful control.

TABLE 8.—*Engineering*

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Soil series and map symbols	Suitability as a source of—			Degree and kind of limitation for—		
	Topsoil	Road fill	Sand and gravel	Foundations for dwellings [1]	Septic tank absorption field	Sanitary landfill, trench type
Kovich gravelly subsoil variant: Kp, Kr, Ks.	Poor: high water table; gravelly or cobbly below a depth of 21 inches.	Poor: high water table; high potential frost action; A–6 material to a depth of 21 inches, A–1 material below.	Unsuitable to a depth of 29 inches; fair below a depth of 29 inches: high water table.	Severe: high potential frost action; high water table; moderate bearing strength in top 21 inches.	Severe: high water table.	Severe: high water table; rapid permeability; very gravelly or cobbly.
Lake Janee: LAE	Poor: coarse fragments.	Fair if slope is less than 25 percent, poor if more than 25 percent: cobbly.	Poor for sand, unsuitable for gravel: excessive fines.	Severe if slope is more than 15 percent; moderate frost action.	Severe: steep; bedrock a problem in places.	Severe: steep; bedrock a problem in places.
Little Pole: LPD, LPF	Poor: very cobbly; shallow; steep.	Poor: shallow over bedrock; steep; very cobbly.	Unsuitable	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.
Logan variant: Lr	Poor: high in content of lime and clay; high water table.	Poor: high water table; high shrink-swell; high potential frost action; mostly A–6 or A–7 material in top 29 inches, A–1 material below.	Good below a depth of 29 inches: high water table.	Severe: high water table; high shrink-swell; high potential frost action.	Severe: high water table.	Severe: high water table; very gravelly; very rapid permeability below a depth of 29 inches.
Manila: MaB, MaC, MaD.	Good if slope is less than 8 percent, fair if 8 to 15.	Poor: high shrink-swell; mostly A–7 material; moderate potential frost action.	Unsuitable	Severe if slope is more than 15 percent, moderate if less than 15; moderate potential frost action: high shrink-swell below a depth of 26 inches.	Severe: slow permeability.	Severe: clayey.
*McPhie: MCF, MHF For Henefer soil in MHF, refer to Henefer series.	Poor: steep; cobbly.	Poor: slope more than 25 percent; mostly A–1 or A–2 materials.	Unsuitable	Severe: steep.	Severe: steep; cobbly.	Severe: steep; very cobbly.
Mult variant: MRE, MSD.	Good if slope is less than 8 percent, fair if 8 to 15, poor if more than 15.	Poor if slope is more than 25 percent: high potential frost action and A–6 material in upper 32 inches. Fair below a depth of 32 inches if slope is less than 25 percent: moderate potential frost action; A–2 material.	Unsuitable	Severe if slope is more than 15 percent, moderate if less than 15: moderate bearing strength.	Severe if slope is more than 15 percent, moderate if 8 to 15: moderate permeability; bedrock a problem in places.	Severe if slope is more than 25 percent, moderate if less than 25 percent: bedrock a problem in places.

interpretations—Continued

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear first column]

Degree and kind of limitation for—			Soil features affecting—			
Sewage lagoons	Local roads and streets	Shallow excavations	Pond reservoirs	Embankments	Agricultural drainage	Irrigation
Severe: high water table.	Severe: high water table; high potential frost action in upper 21 inches.	Severe: high water table; high in content of coarse fragments.	High permeability in sandy and gravelly subsoil; high water table.	Stratified and variable; high permeability below a depth of 21 inches.	High water table; some outlet limitation.	Undulating topography; depth to coarse material variable; needs careful control.
Severe if slope is more than 7 percent, moderate if 3 to 7: coarse fragments.	Severe if slope is more than 15 percent: cobbly; erodible; moderate potential frost action.	Severe: steep; high in content of coarse fragments.	Coarse fragments; steep; bedrock a problem for excavated ponds in places.	Very cobbly; fair compaction; medium to high susceptibility to piping.	Not applicable	Not applicable.
Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Shallow over bedrock.	Low shear strength; limited material.	Not applicable	Not applicable.
Severe: high water table; rapid permeability below a depth of 29 inches.	Severe: high water table; high potential frost action; high shrink-swell; mostly A–6 or A–7 material.	Severe: high water table; clay surface; high in content of coarse fragments below a depth of 29 inches.	High water table; high permeability below a depth of 29 inches.	Low shear strength; fair compaction to a depth of 29 inches; high in content of coarse fragments and permeability below a depth of 29 inches.	Shallow water table; outlets limited in some places.	Needs drainage; undulating topography in some places; needs careful control.
Severe if slope is more than 7 percent, moderate if less than 7 in MaB.	Severe if slope is more than 15 percent: high shrink-swell swell; moderate potential frost action mostly below a depth of 26 inches; A–7 material.	Severe: clayey	Steep in places	Low shear strength; fair compaction.	Not needed	Needs careful control.
Severe: steep; permeability more than 2 inches per hour.	Severe: slope more than 15 percent; cobbly.	Severe: steep	Steep and coarse fragments in places; slope; permeability.	Medium permeability; fair compaction; cobbly.	Not applicable	Not applicable.
Severe: steep	Severe if slope more than 15 percent: A-6 material to a depth of 32 inches; moderate potential frost action.	Severe: steep	Steep in places; permeability; bedrock a problem in places.	Low shear strength above a depth of 32 inches; steep.	Not applicable	Not applicable.

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Soil series and map symbols	Suitability as a source of—			Degree and kind of limitation for—		
	Topsoil	Road fill	Sand and gravel	Foundations for dwellings [1]	Septic tank absorption field	Sanitary landfill, trench type
Poleline: POF	Poor: gravelly; steep.	Poor if slope is more than 25 percent: mostly A–2 material.	Poor for sand at a depth of 60 inches, poor for gravel at a depth of 44 inches, unsuitable for gravel at a depth below 44 inches: steep.	Severe: steep	Severe: steep	Severe: steep
Rasband: RaB, RCC, RdA, RdC.	Good if slope is less than 8 percent, fair if 8 to 15.	Fair in top 30 inches: moderate potential frost action; mostly A–4 material. Good below a depth of 30 inches: mostly A–1 material.	Unsuitable to a depth of 30 inches, poor below a depth of 30 inches.	Moderate: moderate potential frost action in top 30 inches; moderate bearing strength.	Slight: local pollution of streams in places.	Severe: moderately rapid permeability; very cobbly and gravelly below a depth of 30 inches.
Rock land: RO, Rp. No interpretations.						
*Roundy: RRC, RRD, RRE, RRF, RSC, RSD, RUF, RYD. For Cluff soil in RSC and RSD, refer to Cluff series; for Daybell soil in RUF, refer to Daybell series.	Good if not cobbly and slope is less than 8 percent, fair if 8 to 15, poor if more than 15.	Poor if slope is more than 25 percent, fair if less than 25: moderate potential frost action; cobbly; high shrink-swell below a depth of 31 inches; mostly A–7 material.	Unsuitable	Severe for upper 31 inches if slope is more than 15 percent, moderate if less than 15: moderate potential frost action; moderate bearing strength. Severe below a depth of 31 inches: shrink-swell potential; low bearing strength.	Severe: slow permeability; bedrock a problem in places.	Severe: clayey below a depth of 31 inches; bedrock a problem in places.
Sessions: SEC, SED	Fair: fine texture.	Poor: moderate potential frost action; high shrink-swell; mostly A–6 or A–7 material.	Unsuitable	Severe if slope is more than 15 percent: high shrink-swell; moderate potential frost action; moderate bearing strength.	Severe: slow permeability; bedrock a problem in places.	Severe: clayey; bedrock a problem in places.
Spaa: SpB	Poor: shallow over travertine.	Poor: high potential frost action; shallow over travertine.	Unsuitable	Severe: high potential frost action; shallow over travertine.	Severe: shallow over travertine.	Severe: shallow over travertine.

interpretations—Continued

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear first column]

Degree and kind of limitation for—			Soil features affecting—			
Sewage lagoons	Local roads and streets	Shallow excavations	Pond reservoirs	Embankments	Agricultural drainage	Irrigation
Severe: steep; permeability more than 2 inches per hour.	Severe: slope more than 15 percent; moderate potential frost action.	Severe: steep; high in content of coarse fragments.	Steep; high permeability below a depth of 44 inches.	High sucseptibility to piping; medium permeability.	Not applicable..	Not applicable.
Severe: permeability more than 2 inches per hour below a depth of 30 inches.	Moderate: moderate potential frost action; mostly A-4 material to a depth of 30 inches.	Severe: high in content of coarse fragments below a depth of 30 inches.	Steep; medium permeability.	High susceptibility to piping.	Not needed.....	Moderate water-holding capacity.
Severe if slope is more than 7 percent, moderate if less than 7 in RRC. and RSC	Severe if slope is more than 15 percent, moderate if 8 to 15 percent: mostly A-4 material to a depth of 31 inches; moderate potential frost action; high shrink-swell and mostly A-7 material below a depth of 31 inches.	Severe: clayey; steep in most places.	Steep in some places; bedrock a problem for excavated ponds in places.	Cobbly; poor compaction; susceptible to piping to a depth of 31 inches; cobbly; high compressibility; poor compaction below a depth of 31 inches.	Not applicable..	Not applicable.
Severe if slope is more than 7 percent, moderate if less than 7 in SEC.	Severe: high shrink swell; mostly A-7 material; moderate potential frost action.	Severe: clayey...	Bedrock a problem for excavated ponds in places.	Low shear strength; fair compaction; cobbly below a depth of 13 inches.	Not applicable..	Not applicable.
Severe: shallow over travertine.	Severe: shallow over travertine; high potential frost action.	Severe: shallow over travertine.	Shallow over travertine.	Limited material; low strength.	Not needed.....	Shallow over travertine; undulating topography.

TABLE 8.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil that may have in the

Soil series and map symbols	Suitability as a source of—			Degree and kind of limitation for—		
	Topsoil	Road fill	Sand and gravel	Foundations for dwellings [1]	Septic tank absorption field	Sanitary landfill, trench type
Steed variant: St, Sv	Fair where not cobbly.	Good below a depth of 12 inches: mostly A–1 material.	Unsuitable above a depth of 12 inches; good for gravel below a depth of 12 inches.	Moderate: moderate potential frost action in top 21 inches; water table a problem locally in places.	Slight: local pollution into streams in places.	Severe: very gravelly; rapid permeability.
*Van Wagoner: VMF, VWF. For McPhie soil in VMF, refer to McPhie series; no interpretations for Rock outcrop part of VWF.	Poor: cobbly; shallow; steep.	Poor: shallow over bedrock; steep.	Unsuitable	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.
Wallsburg: WBF. No interpretations for Rock outcrop part.	Poor: very cobbly; shallow; steep.	Poor: shallow over bedrock; steep.	Unsuitable	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.
*Watkins Ridge: WcC, WcD, WLC, WLD, WNC, WND. For Clegg soil in WLC and WLD, refer to Clegg series; for Deer Creek soil in WNC and WND, refer to Deer Creek series.	Good if not cobbly and slope is less than 8 percent, fair if 8 to 15.	Poor: mostly A–6 material; moderate potential frost action.	Unsuitable	Severe if slope is more than 15 percent, moderate if less than 15 percent; moderate potential frost action; moderate bearing strength.	Severe: moderately slow permeability.	Moderate: slope as much as 25 percent; clay loam.
Whipstock: WPF, WSC, WSD, WSE.	Good if slope is less than 8 percent, fair if 8 to 15 and not very cobbly, poor if more than 15 and very cobbly.	Poor: high shrink-swell; mostly A–7 material, moderate potential frost action.	Unsuitable	Severe: high shrink-swell; low bearing strength; slope more than 15 percent; moderate potential frost action.	Severe: slow permeability.	Severe: clayey.
*Yeates Hollow: YaB, YEC, YED, YTC, YTD. For Henefer soil in YTC and YTD, refer to Henefer series.	Good if slope is less than 8 percent and not cobbly, fair if 8 to 15 and not cobbly.	Poor: high shrink-swell; mostly A–7 material; moderate potential frost action.	Unsuitable	Severe: high shrink-swell; low cobbly or very cobbly; slope more than 15 percent.	Severe: slow permeability.	Severe: clayey; very cobbly.

[1] If severe frost limitation is compensated for, other limitations apply as shown.

interpretations

different properties and limitations. For this reason it is necessary to follow carefully the instructions for referring to other series that appear first column]

Degree and kind of limitation for—			Soil features affecting—			
Sewage lagoons	Local roads and streets	Shallow excavations	Pond reservoirs	Embankments	Agricultural drainage	Irrigation
Severe: permeability more than 2 inches per hour.	Moderate: moderate potential frost action; mostly A–4 material in top 12 inches, slight below a depth of 12 inches; mostly A–1 material.	Severe: high in content of coarse fragments.	High permeability.	High permeability.	Not needed	Low water-holding capacity; undulating topography.
Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Shallow over bedrock; steep.	Limited material; steep; high susceptibility to piping.	Not applicable	Not applicable.
Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Severe: shallow over bedrock; steep.	Shallow over bedrock; steep.	Limited material; steep; medium susceptibility to piping.	Not applicable	Not applicable.
Severe if slope is more than 7 percent, moderate if less than 7 in WcC, WLC, and WNC.	Severe if slope is more than 15 percent; mostly A–6 material; moderate potential frost action.	Severe if slope is more than 15 percent; moderate if slope is less than 15.	Steep in some places.	Low shear strength; fair compaction.	Not needed	High in content of lime; may irrigate WcC and WcD with careful control.
Severe if slope is more than 7 percent, moderate if less than 7 in WSC.	Severe: slope more than 15 percent; high shrink-swell; cobbly; mostly A–7 material below a depth of 21 inches; moderate potential frost action.	Severe: Clayey	Steep in some places.	Low shear strength; poor compaction; high compressibility.	Not applicable	Not applicable.
Severe: very cobbly. Also severe if slope is more than 7 percent, moderate if less than 7 in YaB.	Severe: slope more than 15 percent; high shrink-swell; very cobbly; mostly A–7 material below a depth of 12 inches; moderate potential frost action.	Severe: clayey; high in content of coarse fragments.	Steep in some places.	Low shear strength; poor compaction; high compressibility.	Not needed	May irrigate YaB; slow intake rate; cobbly in places.

that deal with the amount of sand, silt, and clay they contain.

Table 8 gives interpretations of the engineering properties of the soils in Heber Valley Area. Specific features or characteristics that affect the selection, design, or application of treatment measures and suitability ratings for specific engineering purposes are listed. The features and ratings are based on information in table 7 and on field experience.

These tables have been prepared for the use of landowners, planners, and developers. The information in these tables applies only to the depth of soil given in table 7 under the heading "Depth from surface."

Formation and Classification of the Soils

In this section the factors that influenced soil formation are described and the soil series are classified in higher categories of the current system of classification.

Factors of Soil Formation

The characteristics of the soil at any given point are determined by the interaction of five principal factors: (1) the parent material, (2) the climate in which the soil material has accumulated and has existed since accumulation, (3) the relief, or topography, which influences the local or internal environment of the soil, its drainage, moisture content, aeration, susceptibility to erosion, and exposure to sun and wind, (4) the biological forces—the plants and animals living on or in the soil, and (5) the length of time the climatic and biological forces have acted upon the soil material.

Regional differences in soils usually reflect differences in climate and vegetation, but local differences are more often caused by topography, parent materials, and time. For example, the soils in the survey area formed under climates ranging from moist subhumid in the lower valleys to humid in the high mountains. They formed under vegetation ranging from grasses to aspen and conifer forests and to various kinds of shrubs. The topography ranges from nearly level to very steep, and the parent materials range from quartz diorite porphyry and quartzite, which weather very slowly, to andesites, which weather much more rapidly.

The degree of horizonation or profile development reflects one or more of the factors of soil formation. The soils and alluvial lands along the rivers have been in place for a short period of time and show very little horizonation; whereas some soils on the mountainsides have been there since the Pleistocene epoch and have very pronounced horizonation. Most of the soils are leached of lime and are high in organic matter, reflecting a moderate to high amount of precipitation and good growth of vegetation. The soils in the lower positions receive seepage water from surrounding higher areas and have developed under poor natural drainage. These poorly drained soils are much higher in organic matter and have developed thicker dark surface layers than adjacent soils in better drained positions.

The five factors of soil formation are described in more detail in the following paragraphs.

Parent materials

The parent materials of the soils of the survey area are derived from several kinds of rocks. The major part of the acreage (about 52 percent) formed in materials derived dominantly from mixed sedimentary rocks.

The most extensive soils formed in this material are the Bradshaw, Burgi, Daybell, Deer Creek, Gappmayer, Henefer, Roundy, and Wallsburg soils. Of lesser extent are the Agassiz, Clegg, Bezzant, Cloud Rim, Cluff, Fitzgerald, Manila, Sessions, Whipstock, Watkins Ridge, and Yeates Hollow soils.

Most of the sedimentary rocks are mixed, interlayered, clayey and sandy limestones, calcareous sandstones, and calcareous orthoquartzites. In some places the bedrock is mainly limestone, and in other places it is mainly quartzite or sandstone.

Andesite flows and andesitic tuffs and breccias make up a thick section of volcanic material that filled the valleys of an older erosional surface (*11*). This volcanic material overflowed the sedimentary rocks. At the outer edges of the andesite flows, where the flow was thin, the andesite has weathered away. Only occasional andesite rocks remain on the surface in many of these areas. Volcanic ash also covered much of the area in varying amounts. The soils shown as developing mainly from mixed sedimentary rocks were thus influenced by varying amounts of andesitic material.

About one-third of the survey area consists of soils formed in material derived mostly from andesites. These soils are mainly in the northeast part of the area. Most of this andesitic material has a mantle of glacial drift. The glacial drift is derived mostly from andesitic rocks, but has minor amounts of sedimentary rocks. The soils formed in this material are mainly Baird Hollow, Broadhead, Clayburn, Flygare, and Horrocks soils, Flygare sandy loam subsoil variant, and Mult thick solum variant. Little Pole soil formed in residuum from andesite.

Of minor importance are the Hailman, Lake Janee, and McPhie soils, which formed mainly in glacial drift derived from quartz diorite porphyry. Van Wagoner soils formed in residuum from quartz-diorite porphyry. These soils make up about 4 percent of the survey area.

Soils derived from sandstone are about 1 percent of the survey area. The sandstone is of the Jurassic Nugget (Navajo) Formation and consists of medium-grained to coarse-grained pink sandstone. Brad soils formed in this material.

Soils that formed in materials derived mainly from quartzite are about 1 percent of the survey area. The quartzite rocks are largely of Pennsylvanian age and are of the Weber Formation. They consist of yellowish-brown quartzite with thin beds of cherty limestone. Buell soils formed in this material. Poleline soils formed in similar material.

Soils derived mainly from travertine are about 1 percent of the Area. The travertine was deposited

from limy waters originating in geyserlike hot springs known locally as "hot pots." The Spaa and Cudahy cold variant soils formed in this material.

Center Creek, Crooked Creek, Holmes, Kovich deep water table variant, Kovich gravelly subsoil variant, Kovich, Logan cold variant, Rasband, and Steed cold variant soils and associated miscellaneous land types make up about 10 percent of the Area and formed in materials of mixed origin. These materials consist mainly of alluvium derived from a mixture of several rocks, dominantly sedimentary rocks and andesite.

The effect parent materials have had on the soils can be observed by comparing laboratory data for profiles that are similar in all respects except parent material.

The soils formed in material derived mainly from mixed sedimentary rocks have nearly twice as many coarse fragments in the upper 30 inches as soils formed in the other materials.

Analyses show the sands are coarser in the soils that formed in material derived from andesitic rocks than in soils that formed in material derived from mixed sedimentary rock. Very coarse sand plus coarse sand averaged 16.2 percent of the andesitic soils and 7.9 percent of the soils derived from mixed sedimentary rocks. Fine sand plus very fine sand averaged 25.5 percent of the andesitic soils and 33.4 percent of the mixed sedimentary soils. The ratios of fine plus very fine sand to very coarse plus coarse sand averaged 1 to 6 for the andesitic soils and 4 to 2 for mixed sedimentary soils. The difference between the two ratios is statistically significant. Although andesitic rocks generally weather rapidly, some constituent minerals weather more rapidly than others; therefore the less weatherable parts remain and form the coarse sand fraction.

The average base saturation percentage in soils classified as Paleborolls is lower in soils derived from andesitic rocks than in those derived from mixed sedimentary rocks. These average values are 70 percent base saturation in soils derived from andesitic rocks, and 81 percent in soil derived from mixed sedimentary rocks. The higher base saturation of soils formed in sedimentary materials probably results from the higher lime content of rocks.

The ratio of cation exchange capacity to clay content appears to be about the same for the soils, regardless of parent material.

The surface soil colors are about the same regardless of parent material. The B2t horizon colors have slightly brighter chromas and slightly redder hues in soils that formed in mixed sedimentary material than in material derived from andesitic rocks.

There is strong evidence of a loess mantle over much of this area. The evidence is chiefly that the surface layers of many soils are much higher in silt than their subsoils or substrata. Examples are the Baird Hollow, Daybell, Deer Creek, Gappmayer, Henefer, and Lake Janee soils.

Climate

The climate in the Heber Valley Area ranges from moist subhumid in the valleys to humid in the high mountains. It is characterized by cold, moist winters and cool, somewhat dry summers. The average annual precipitation is about 16 inches at Heber, 23 inches at the Snake Creek power plant west of Midway, and 41 inches at Silver Lake (Brighton) in nearby Salt Lake County. The largest amount of precipitation falls from December to March, and the least during June and July. Most of the precipitation comes in the form of snow.

The mean annual air temperatures are 44° F at Heber, 43° at the Snake Creek power plant, and 36.5° at Silver Lake. The average frost-free period is 83 days at Heber and 93 days at the Snake Creek power plant. No information is available for higher elevations in the area.

In the Heber Valley Area climate is a cofactor with elevation. In general the precipitation increases and the temperature decreases with increases in elevation, but the relationship varies somewhat for varying exposures.

The effects of precipitation on soil are measured in part by the amount and depth of relocation of the various components of the soil. The effects of climate are more distinct in the oldest, or mature, soils and less distinct in the most recent soils. A change of climate is generally accompanied by a change in vegetation. Soils that have 16 to 20 inches of precipitation and an average annual air temperature of about 44° F at elevations of 5,500 to 6,000 feet are mainly Argixerolls. These soils formed under a cover of grasses and shrubs. Under this amount of precipitation, lime has been leached from the surface layer and deposited in the substratum below the B2t horizon. The lime horizons have their upper boundaries at an average depth of about 28 inches. Clay has accumulated in the B2t horizon, and base saturation is about 90 to 100 percent. The B2t horizon has its upper boundary at an average depth of about 13 inches and it averages about 28 inches thick.

Soils that have 20 to 25 inches of precipitation at elevations of 6,000 to 7,000 feet are also mainly Argixerolls. These soils formed under similar vegetation to soils at the lower elevations, although shrubs make up a higher percentage of the total vegetation. These soils have no accumulations of lime in the profile within a depth of 5 feet. Clay has accumulated in the B2t horizon, and base saturation is about 85 percent. The B2t horizon has its upper boundary at an average depth of about 17 inches and averages about 31 inches in thickness.

Soils that have 25 to 35 inches of precipitation and temperatures of 40° F or less at elevations of 7,500 to 9,000 feet are mainly Cryoborolls, Paleborolls, Cryoboralfs, and Paleboralfs. These soils have no lime in the profile. They have accumulations of clay in the B2t horizon. They formed under a vegetative cover of aspen, spruce-fir, shrubs, and grass. They have thick, distinct horizons. The B2t horizon has its upper boundary at an average depth of about 24 inches and average about 38 inches in thickness.

A temperature study by Paul W. Conrad[4] shows

[4] CONRAD, PAUL W. Comparison of aid and soil temperature in four vegetative types. 1963. [Unpublished master's thesis, Brigham Young University.]

relationships between elevation and soil depth. Average summer temperatures were determined for the air and for the soil at three depths and at four elevations in this survey area during the summer of 1959. These were determined by the sugar inversion method (*5*).

The average summer air temperature decreased about 2° F per 1,000-foot increase in elevation at elevations below 7,000 feet. North exposures were not significantly different from the south or west exposures in this regard. The average summer soil temperatures decreased about 2° to 3° per 1,000-foot increase in elevation. The average summer air temperature was 3° to 4° higher than the soil temperature at a depth of 4 inches. Soil temperatures at 4 inches were 3° to 6° higher on south exposures than on north exposures at comparable elevations. The differences were less pronounced at elevations above 7,000 feet. Summer soil temperatures at a depth of 20 inches were about 1° or 2° lower than at 4 inches, and those at a depth of 40 inches were about 2° lower than those at 20 inches. The Argixerolls and Palexerolls at elevations below about 6,000 feet have an average summer air temperature of about 64°, and a soil temperature of 61° to 62° at 4 inches depth, of 60° at 20 inches depth, and of 57° at 40 inches depth. The Argixerolls at elevations between 6,000 and 8,000 feet have temperatures about 2° to 3° colder for both air and soil; and Cryoborolls, Paleborolls, Cryoboralfs, and Paleboralfs at elevations above 7,000 feet have temperatures 3° to 4° colder.

Relief

The survey area consists of bottom land in Heber and Round Valleys surrounded by stream terraces, alluvial fans, foothills, mountains, and plateaus. The slopes range from nearly level in the valley bottoms to very steep on the mountains. The elevations range from 5,200 to 10,000 feet.

The flood plains and stream terraces in the wet valley bottoms consist of recent alluvium and soils that have lime horizons. These soils are poorly drained or somewhat poorly drained due to seepage of water from higher-lying springs, or from irrigation of adjacent higher land. The somewhat poorly drained Center Creek soils and the poorly drained Crooked Creek, Kovich, and Logan cold variant soils are on the flood plains and low stream terraces. These soils have accumulated large quantities of organic matter. In addition, their characteristics indicate restricted aeration.

The somewhat poorly drained soils have mottling at depths of 27 to 39 inches and have matrix chromas of 1 to 3 dry and 2 moist. The poorly drained soils have more pronounced evidence of impeded aeration. Crooked Creek and Kovich soils have mottling between 5 and 12 inches from the surface and have matrix chromas of 1 or 2. The Logan cold variant has a ca horizon within 10 inches of the surface and a chroma of 1. Micro-organisms living in such soils must have oxygen in order to decompose organic matter and derive energy for their metabolism. When the aeration is restricted by a high water table they must get oxygen from other sources. If oxygen is removed from ferric oxide (Fe_2O_3), it is converted to ferrous oxide (FeO). Ferrous oxide, which is water soluble, is blue, green, or neutral in color and, consequently, low in chroma.

When oxygen enters the soil through pores, root channels, or wormholes, the ferrous iron or iron-rich minerals are oxidized to ferric oxide and turn red. This is the reason for the mottling. The characteristics of these soils are largely the result of their position on the landscape and drainage.

In the Midway area travertine terraces are formed by deposition from warm springs highly charged with lime. As the water pressure in the springs lessens and the water cools, lime is precipitated and layered travertine deposits form. Where the topography is flat, poorly drained soils formed. In other places the topography is gently to strongly sloping, and better drained soils have formed. The soils in this landscape are high in lime deposited by hot springs water and are shallow or only moderately deep over travertine bedrock. The Spaa soils and Cudahy cold variant, which formed in travertine deposits, are very limited in acreage and make up about 1 percent of the survey area.

Adjacent to the valley bottoms are the stream terraces formed in glacial outwash deposits. They have from 2 to 6 feet of soil over gravel and cobbles. The surface is generally smooth, but is channeled and uneven in places. This landform consists chiefly of Holmes and Rasband soils. The relief is such that erosion has not been excessive, and the soils are well aerated. The soils have developed a weak to moderate B horizon and have lime-free profiles, mainly because the parent material is lime free. This topography is very limited in acreage, making up about 3 percent of the survey area.

Closely associated with the stream terraces are the alluvial fans and colluvial cones along the perimeter of the valleys. These landforms more or less follow a contour. The parent materials on some of these fans were high in lime. Watkins Ridge, Deer Creek, and Clegg are the principal soils. These soils have an accumulation of lime in the profile. Watkins Ridge soils are on the ridges on convex positions. Their parent material was apparently high in lime, because the profile averages 38 percent. The high lime content is associated with ridges or convex relief. The contour of these soils suggests their high lime content may have been caused by precipitation of lime in the shallow waters near the shore of a former lake. Subsequent to recession of the lake, normal leaching of the lime took place in the soil and concentrated it in the substratum. This leaching together with less effective precipitation of the knolls and ridges resulted in a plant cover less able to control the erosion. As the lime was leached downward, the lime-free surface layers could have been removed and the remaining soil thus increased in lime content. No B horizon has formed in this soil.

Deer Creek soils are closely associated with Watkins Ridge soils and are in the concave or swale positions. Their surface layer is leached of lime, but strong textural B2t horizons have formed and are underlain by strong lime horizons. The lime content of the parent material of Deer Creek soils averages 25 percent. The Clegg soils formed in parent material de-

rived mainly from igneous rocks. They have only about half as much lime in their profiles as the associated Watkins Ridge and Deer Creek soils.

Above the old alluvial fans are the mountainsides or plateau scarps. They are generally steep or very steep and have a mantle of glacial drift, colluvium, or alluvium. In some places the soils formed in residuum from the underlying bedrock. Elevations range from 5,500 to 9,500 feet. The effects of relief are difficult to isolate because they are generally associated with other variables such as vegetation, climate, and time. Daybell and Roundy soils are similar except for relief and texture of parent material. Daybell soils are generally very steep and have slopes of 40 to 65 percent. They have a very gravelly, coarse-textured subsoil and lack a B horizon. Roundy soils are generally sloping to moderately steep and have slopes of 5 to 25 percent. They have a cobbly fine textured B2t horizon. Gappmayer soils mostly have very steep slopes. They have a very cobbly moderately fine textured B2t horizon.

Exposure influences the effectiveness of precipitation and the kind of plant cover on a soil. The Cloud Rim and Horrocks soils are dominantly on south-facing slopes. Gappmayer and McPhie soils are on north-and east-facing slopes at somewhat comparable elevations. Roundy soils are on all exposures. On south-facing slopes they occur at elevations of about 8,000 feet, whereas on north-facing slopes they occur at elevations as low as 6,000 feet. The Baird Hollow and Fitzgerald soils are dominantly on north- or east-facing slopes above 8,000 feet in elevation.

In summary, relief and landform have greatly influenced the soils of the Heber Valley Area. In the valley bottoms on nearly level relief, somewhat poorly or poorly drained soils have formed. These soils have high organic-matter content, low chromas, and mottling, and some have lime horizons within 10 inches of the surface.

At the higher elevations, on mountains and high mountains, are the very steep soils that have minimal development. Soils that have medium development formed in all positions but mostly in moderately steep to steep areas. Soils that have maximum development are mostly moderately steep. Exposure must also be evaluated along with relief and landform. North-facing slopes have cooler temperatures than south-facing slopes and lower evaporation-transpiration rates. For this reason the same soils may occur at different elevations, depending on direction of exposure.

Living organisms

Plants strongly influence the kind, amount, and position of organic matter in the soil. Living organisms induce soil structure and porosity, and thus influence the rate of air and water movement through the soil. Plants and animals mix the soil and retard horizon formation. The decay of forest litter causes the formation of acids. These acids hasten the leaching of bases from the soil.

In the Heber Valley Area there are seven main vegetative areas.

1. The wet valley areas have a cover of dominantly water-loving sedges, wiregrass, cottonwood, alder, river birch, and hawthorn. The grass and grasslike plants contribute large amounts of organic matter to the soil. The Center Creek, Crooked Creek, and Kovich soils have thick dark surface horizons. All of these soils have high water tables. Because they have a plentiful supply of available water, these soils produce the highest yield of herbage.
2. The foothills, alluvial fans, and stream terraces have a cover of grasses, shrubs, and forbs grown under 16 to 20 inches of precipitation. Thickness of the A1 horizon averages about 8 inches. The Bezzant, Clegg, Deer Creek, Watkins Ridge, and Whipstock soils have a dark-colored surface horizon and strong accumulations of lime in the lower horizons. Also in the Area are Holmes, Manila, Rasband, and Spaa soils.
3. The low mountain slopes have a vegetative cover of grasses, shrubs, and forbs under 20 to 25 inches of precipitation. Thickness of the A1 horizon averages 11 inches. There is no A2 horizon. The Bradshaw, Broadhead, Burgi, Cloud Rim, Henefer, Horrocks, and Yeates Hollow soils are deep, have thick dark-colored surface layer and are leached of lime. The soils on the northerly exposures have thicker dark-colored horizons than those on the southerly exposures. Shallow soils include Agassiz, Brad, Little Pole, Wallsburg, and Van Wagoner. These soils have a total annual yield of about 2,200 pounds of herbage per acre.
4. The low mountain slopes have a cover of dominantly shrubs, mostly oakbrush, under 20 to 25 inches precipitation. Soils in this vegetative area have an A2 horizon about 16 inches thick. Their B2t horizon is similar to soils in Vegetative Area 3. The Gappmayer and McPhie soils have albic and argillic horizons.
5. The high mountain plateaus have a vegetative cover of grasses, shrubs, and forbs under 25 to 35 inches of precipitation. Soils in this group have an A1 horizon 20 inches thick. The Buell, Clayburn, and Sessions soils have thick dark-colored surface horizons. The total annual yield per acre is about 2,600 pounds of herbage.
6. The high mountain slopes have a cover of aspen and an understory of grasses and shrubs under 25 to 35 inches of precipitation. Soils in this vegetative area have an A1 horizon 20 inches thick, an A2 horizon 10 inches thick, and a B2 horizon about 33 inches thick. Organic-matter content is higher than in Vegetative Areas 5 and 7.
7. The high mountain slopes have a vegetative cover of Alpine fir, white fir, Douglas-fir, and Engelmann spruce with some scattered aspen and a sparse understory of shrubs and grasses. The precipitation is 25 to 35 inches. Soils in this group have a thin A1 horizon that averages only 4 inches. The A2 horizon averages 15 inches in thickness. The content of organic matter is lower than in Vegetative Areas 5 and 6.

Time

The degree of formation of soil horizons depends in part upon time. Soil classified as Haploxerolls, Haplaquolls, and Cryborolls are all relatively youthful. They show a minimum of horizonation or profile development. The development consists almost exclusively of a buildup of organic matter in the A1 horizon and a consequent darkening of the color. Of these soils, Kovich deep water table variant, Steed cold variant, and Kovich soils are on the flood plains where periodic overflow has been responsible for deposition of the parent materials. Soil horizon development has been limited to the time between deposition periods. The Agassiz, Brad, Little Pole, and Van Wagoner soils formed in residuum on steep slopes. Erosion has nearly kept pace with rock weathering. These soils have a buildup of organic matter at the soil surface and have some redistribution of lime.

The organic-matter content of a soil seems to come into equilibrium with the soil moisture in a relative short time in this area. For example, in a comparable climate three young soils, Van Wagoner, Little Pole, and Burgi, all show no profile development other than accumulation or organic matter. They have about three-fourths as much organic matter in the top 5 inches as the other three—Cloud Rim, Horrocks, and Henefer soils. Logan cold variant in the valley bottom has probably been wet for a longer period of time than the other soils and has accumulated about 8 to 12 percent organic matter in the top 5 inches. Kovich soils and Cudahy cold variant have an average of about two-thirds as much organic matter in the upper 5 inches as the Logan cold variant.

Spaa, Bezzant and Watkins Ridge soils all show a 2.5- to 5-percent buildup of organic matter in the top 5 inches and a redistribution of lime in the profile. Bezzant and Watkins Ridge soils have strong lime horizons. These soils apparently had so much carbonate in the parent material that clay movement and the resultant B2t horizon development have not taken place. The travertine on which Spaa soils formed is 60 percent carbonates. The Bezzant soil averages 31 percent and the Watkins Ridge soil 38 percent carbonate throughout the profile.

Soils on stream terraces and many of the alluvial fans appear to be of intermediate age (although some fans appear to be quite old). These soils formed in glacial outwash. They have weak to moderate B2t horizons in addition to a darkened surface layer. Some have a lime horizon just below the B horizon. Clegg and Center Creek soils are in these positions.

The soils with the greatest degree of horizonation are oldest and occur mostly in the mountains. Some are on mountainsides and some are in glacial moraines. A few are on alluvial fans and stream terraces. Except for the Cluff soils, all have thick dark A1 horizons and all have strongly expressed B2t horizons. The Roundy, Baird Hollow, and Cluff soils have a thick, strongly expressed A2 horizon. Also, the Deer Creek and Whipstock soils have lime horizons. These soils have a maximal B2t horizon. Broadhead, Henefer, Manila, Sessions, and Yeates Hollow soils lack an A2 horizon but have thick A1 and maximal B2t horizons.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (*9*). Because this system is under continual study, readers interested in developments of the current system should search the latest literature available.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. Classes of the current system are briefly defined in the following paragraphs.

Order.—Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. Two exceptions are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Molli-i-sol).

Suborder.—Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging, or soil difference resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquoll* (*Aqu*, meaning water or wet, and *oll*, from Mollisol).

Great Group.—Soil suborders are divided into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark-colored surface horizons. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of

great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example of Haplaquolls (*Hapl*, meaning simple horizons, *aqu* for wetness or water, and *oll* from Mollisols).

Subgroup.—Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Cumulic Haplaquolls (a Haplaquoll with thick dark upper horizons).

Family.—Soil families are established within each subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineral content, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae. An example is the fine, montmorillonitic, frigid family of Cumulic Haplaquolls.

Table 9 lists the soil series in the Heber Valley Area and classifies them by family, subgroup, and order.

Laboratory Data

The results of laboratory analyses of selected soil samples are shown, by horizon, in tables 10 and 11. The analyses were made by the Soil Conservation Service and Utah State University Cooperative Soils Laboratory, Logan, Utah.

Methods of Analyses

All samples were air dried in the laboratory. They were then sieved by hand, using sieves 8 inches in diameter that have round, 2-millimeter openings. Samples that appear to have no appreciable amount of pebbles or stones (less than 5 percent) were poured through a mechanical crusher that has openings about 4 millimeters in diameter. Samples that contained an appreciable amount of pebbles or stones were broken up in an iron mortar without crushing the pebbles or stones. Where it was necessary to reduce the size of the sample, a Riffle sampler was used. Each laboratory sample was mixed thoroughly to insure uniformity, and all subsequent analyses were made on the fraction that was less than 2 millimeters in diameter. Subsamples less than 2 millimeters in diameter were ground small enough to pass a sieve of 0.3 millimeter by use of a mortar and pestle. These subsamples were used to determine the organic carbon and calcium carbonate equivalent.

The pipette method of analysis was used to determine particle size distribution. Organic matter was destroyed by using hydrogen peroxide; except where specifically stated in the survey, lime was not removed. Sodium hexametaphosphate was used as a dispersing agent. The pipette method of analysis was used on material less than 2 millimeters in diameter. The amount of sand, silt, and clay is expressed on the basis of the oven-dry material.

The reaction, or pH, was measured with a line-operated pH meter using a glass electrode with a calomel reference electrode. A soil-water suspension of one to one was used.

The wet oxidation method using chromic acid was used to determine the organic carbon. Samples were heated during the oxidation process as described in the U.S. Department of Agriculture Handbook No. 60 (*8*). Silver sulfate was added to the sulfuric acid to prevent oxidation of chlorides for samples where soluble salts were 0.1 percent or more. After oxidation and dilution, an excess of ferrous ammonium sulfate was added to the sample, and the sample was then titrated with standard potassium permanganate. The permanganate also acted as an indicator, and a special titration light was used to help determine the exact end-point. The organic-matter content was obtained by multiplying the percentage of organic carbon by 1.7.

The macro-Kjeldahl method was used to determine total nitrogen with selenium as a catalyst. Enough water (about 15 to 20 millimeters) was added to the soil and other material in the flask to thoroughly wet the material before adding the acid for distillation. The distilled ammonia was caught in a 2-percent boric acid solution containing a special mixed indicator of bromcresol green and new coccine. The ammonia was then titrated with standard solution ($^1/_{14}$ normal) of sulfuric acid, and the total amount of nitrogen was determined.

A pipette cell with platinized platinum electrodes with a cell constant of 0.5 was used along with a resistance bridge for measurement of electrical conductivity of saturation extract. The pipette cell was equipped with a tapping key switch to avoid excessive flow of electric current which could have heated the solution or polarized the electrodes. All values are expressed at 25° C.

To determine the calcium carbonate equivalent, the technician allowed variable weights of the sample to react in constant glass containers with 2 normal hydrochloric acid. The percentage of calcium carbonate equivalent was determined by referring manometer readings to a curve prepared from standard samples of calcium carbonate.

In determining the cation-exchange capacity, samples of soil material less than 2 millimeters in diameter were saturated with sodium by four consecutive washings and centrifugations using 1 normal sodium acetate solution that had been adjusted to pH 8.2. The soluble sodium acetate was removed by washing with a 95-percent solution of ethanol. The exchangeable sodium was then removed by three consecutive washings with neutral normal ammonium acetate. The amount of sodium was then measured on the flame photometer.

Extractable bases are sodium and potassium. Sodium was extracted by washing the sample three times with neutral normal ammonium acetate, followed each time with centrifugation and filtering. The final extraction was at the ratio of 1 to 25. The amount of sodium in this extract was then measured using the flame photometer with lithium as the inter-

TABLE 9.—*Soil series classified according to the current system of classification* [1]

Series	Family	Subgroup	Order
Agassiz	Loamy-skeletal, mixed, frigid	Lithic Haploxerolls	Mollisols.
Baird Hollow	Clayey-skeletal, montmorillonitic	Cryic Paleborolls	Mollisols.
Bezzant	Loamy-skeletal, mixed, frigid	Typic Calcixerolls	Mollisols.
Brad	Sandy-skeletal, mixed, frigid	Lthic Haploxerolls	Mollisols.
Bradshaw	Loamy-skeletal, mixed, frigid	Typic Haploxerolls	Mollisols.
Broadhead	Fine, montmorillonitic, frigid	Pachic Argixerolls	Mollisols.
Buell	Loamy-skeletal, mixed	Typic Cryumbrepts	Inceptisols.
Burgi	Loamy-skeletal, mixed, frigid	Cumulic Haploxerolls	Mollisols.
Center Creek	Fine-loamy, mixed	Pachic Argiborolls	Mollisols.
Clayburn	Fine-loamy, mixed	Argic Pachic Cryoborolls	Mollisols.
Clegg	Fine-loamy, mixed, frigid	Calcic Pachic Argixerolls	Mollisols.
Cloud Rim	Fine-loamy, mixed, frigid	Typic Argixerolls	Mollisols.
Cluff	Clayey-skeletal, montmorillonitic	Mollic Cryoboralfs	Alfisols.
Crooked Creek	Fine, montmorillonitic, frigid	Cumulic Haploquolls	Mollisols.
Cudahy variant	Fine-silty, mixed, frigid	Petrocalcic Calciaquolls	Mollisols.
Daybell	Coarse-loamy over fragmental, mixed	Pachic Cryoborolls	Mollisols.
Deer Creek	Fine, montmorillonitic, frigid	Typic Palexerolls	Mollisols.
Fitzgerald	Loamy-skeletal, mixed	Mollic Paleboralfs	Alfisols.
Fluventic Haploborolls	Sandy-skeletal, mixed, frigid	Fluventic Haploborolls	Mollisols.
Flygare	Loamy-skeletal, mixed	Cryic Pachic Paleborolls	Mollisols.
Flygare variant	Loamy-skeletal, mixed	Argic Pachic Cryoborolls	Mollisols.
Gappmayer	Loamy-skeletal, mixed, frigid	Boralfic Argixerolls	Mollisols.
Hailman	Coarse-loamy, mixed	Pachic Cryoborolls	Mollisols.
Henefer	Fine, montmorillonitic, frigid	Pachic Argixerolls	Mollisols.
Holmes	Loamy-skeletal, mixed, frigid	Typic Argixerolls	Mollisols.
Horrocks	Loamy-skeletal, mixed, frigid	Typic Agrixerolls	Mollisols.
Kovich gravelly subsoil variant	Coarse-loamy over sandy or sandy-skeletal, mixed, frigid.	Typic Haplaquolls	Mollisols.
Kovich	Fine-loamy, mixed, frigid	Cumulic Haplaquolls	Mollisols.
Kovich deep water table variant	Fine-loamy, mixed, frigid	Cumulic Haploxerolls	Mollisols.
Lake Janee	Coarse-loamy, mixed	Typic Cryochrepts	Inceptisols.
Little Pole	Loamy-skeletal, mixed, frigid	Lithic Haploxerolls	Mollisols.
Logan variant	Fine-loamy, mixed, frigid	Cumulic Haplaquoll	Mollisols.
Manila	Fine, montmorillonitic, frigid	Typic Argixerolls	Mollisols.
McPhie	Coarse-loamy, mixed, frigid	Boralfic Argixerolls	Mollisols.
Mult variant	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Poleline	Loamy-skeletal, mixed	Pachic Cryoborolls	Mollisols.
Rasband	Fine-loamy, over fragmental, mixed, frigid	Typic Argixerolls	Mollisols.
Sessions	Fine, montmorillonitic	Argic Cryoborolls	Mollisols.
Spaa	Loamy, mixed, frigid	Lithic Haploxerolls	Mollisols.
Steed variant	Sandy-skeletal, mixed, frigid	Entic Haploxerolls	Mollisols.
Van Wagoner	Loamy-skeletal, mixed, frigid	Lithic Haploxerolls	Mollisols.
Wallsburg	Clayey-skeletal, mixed, frigid	Lithic Argixerolls	Mollisols.
Watkins Ridge	Fine-loamy, mixed, frigid	Typic Calcixerolls	Mollisols.
Whipstock	Very fine, montmorillonitic, frigid	Typic Palexerolls	Mollisols.
Yeates Hollow	Clayey-skeletal, montmorillonitic, frigid	Typic Argixerolls	Mollisols.

[1] Placement of soil series in the current system of classification may change as more precise information becomes available.

TABLE 10.—*Mechanical analyses of representative soils*

[Analyses made in cooperative soils laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service]

Soil type and horizon	Depth from surface	Size class and diameter of particles							
		Very coarse sand (2.0–1.0 mm)	Coarse sand (2.0–1.0 mm)	Medium sand (0.5–0.25 mm)	Fine sand (0.25–0.10 mm)	Very fine sand (0.10–0.05 mm)	Silt (0.05–0.002 mm)	Clay (less than 0.002 mm)	Estimated coarse fragments (Vol)
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Baird Hollow loam:									
A11	0–5	2.4	7.4	6.0	11.1	10.6	48.3	14.2	0
A12	5–22	2.4	7.2	5.7	10.3	11.8	32.9	29.7	20
A & B	22–29	3.4	8.5	8.3	15.7	14.6	21.4	28.1	50
B21t	29–38	2.5	8.4	7.3	13.3	12.2	19.6	36.7	50
B22t	38–55	2.4	7.9	6.8	11.5	10.7	18.3	42.4	50
B23t	55–72	2.5	7.3	6.8	11.6	10.7	17.0	44.1	50

TABLE 10.—*Mechanical analyses of representative soils*—Continued

[Analyses made in cooperative soils laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service]

Soil type and horizon	Depth from surface	Size class and diameter of particles							
		Very coarse sand (2.0–1.0 mm)	Coarse sand (2.0–1.0 mm)	Medium sand (0.5–0.25 mm)	Fine sand (0.25–0.10 mm)	Very fine sand (0.10–0.05 mm)	Silt (0.05–0.002 mm)	Clay (less than 0.002 mm)	Estimated coarse fragments (Vol)
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Bezzant very cobbly loam:									
A11	0–2	4.9	5.7	5.6	16.4	17.6	28.2	21.6	50
A12	2–10	4.0	4.4	4.9	16.1	17.9	31.9	20.8	60
AC	10–16	2.2	4.1	5.3	15.0	17.6	30.4	25.4	75
C1ca	16–25	2.2	3.6	4.8	13.6	15.2	31.4	29.2	70
C2ca	25–60	4.3	7.6	7.1	16.4	14.4	25.7	24.5	70
Bradshaw very cobbly very fine sandy loam:									
A11	0–3	5.1	3.7	3.4	15.6	33.3	29.1	9.8	60
A12	3–11	3.6	2.9	2.5	14.4	34.5	28.7	13.4	50
B2	11–29	2.9	2.1	2.3	12.6	32.7	32.1	15.3	65
C1	29–40	1.4	2.0	2.3	12.0	30.6	36.3	15.4	70
C2	40–62	1.1	2.2	3.4	13.8	28.0	35.2	16.3	80
Broadhead very cobbly loam:									
A11	0–5	6.1	10.2	7.2	12.3	11.3	26.1	26.8	50
A12	5–12	3.1	7.5	5.8	10.4	11.9	35.5	25.8	0
B21t	12–22	1.2	3.2	3.4	6.0	9.0	28.5	48.7	0
B22t	22–34	1.4	5.4	4.2	6.8	10.3	27.0	44.9	0
B3	34–44	2.9	5.7	4.1	16.9	9.9	27.6	32.9	0
C1	44–60	0.8	3.3	2.5	4.7	13.3	61.5	13.9	0
Buell gravelly loam:									
A11	0–5	6.0	6.9	3.8	2.0	13.5	46.3	16.5	45
A12	5–15	3.5	6.0	4.0	7.5	14.2	48.3	16.5	45
A13	15–29	7.5	8.8	4.5	7.8	13.3	44.2	13.9	55
B21	29–56	5.8	8.8	5.0	8.2	12.3	45.7	14.2	70
B22	56–60	11.1	9.5	4.8	9.2	16.3	39.9	9.8	70
B23	60–62+	10.9	9.2	4.6	8.8	15.6	40.5	10.4	70
Burgi gravelly loam:									
A11	0–2	6.1	6.5	4.0	12.8	14.4	43.4	12.8	20
A12	2–12	4.3	6.9	4.3	13.6	15.9	46.5	8.5	20
A13	12–26	3.1	5.5	4.2	13.1	16.2	47.9	10.0	45
C1	26–39	3.3	5.6	4.5	13.7	16.9	46.3	9.7	45
C2	39–60	3.5	6.0	4.7	14.3	16.5	46.0	9.0	45
Center Creek loam:									
Ap	0–5	3.2	4.0	3.9	12.6	19.0	35.4	21.9	0
A12	5–12	3.1	3.3	3.4	11.1	19.3	38.4	21.4	0
B1	12–20	4.0	3.4	3.5	12.1	18.8	31.8	26.4	0
B2t	20–33	2.0	2.2	2.8	12.6	20.8	28.2	31.4	0
B3	33–40	12.8	13.6	10.3	19.0	16.6	22.1	15.6	50
C1	40–50	3.8	3.7	4.2	18.1	25.0	23.3	21.9	50
C2	50–60	19.1	16.3	10.1	15.6	11.5	10.8	16.6	70
Clayburn loam:									
A11	0–2	8.3	12.7	6.7	11.1	11.9	25.8	23.5	0
A12	2–12	7.2	11.7	6.1	11.0	12.2	28.7	23.1	0
A13	12–18	5.4	11.0	6.3	12.0	12.5	28.0	24.8	0
B1	18–24	6.3	10.8	6.4	11.5	11.4	28.7	24.9	0
B21t	24–36	6.6	7.1	3.7	14.7	13.5	20.3	34.1	0
B22t	36–41	7.8	12.1	5.8	13.2	12.7	20.5	27.9	0
C1	41–48	19.2	17.7	7.3	13.0	13.3	17.5	12.0	40
C2	48–60	13.4	18.8	8.7	14.7	13.7	19.8	10.9	50

TABLE 10.—*Mechanical analyses of representative soils*—Continued

[Analyses made in cooperative soils laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service]

Soil type and horizon	Depth from surface	Size class and diameter of particles							
		Very coarse sand (2.0–1.0 mm)	Coarse sand (2.0–1.0 mm)	Medium sand (0.5–0.25 mm)	Fine sand (0.25–0.10 mm)	Very fine sand (0.10–0.05 mm)	Silt (0.05–0.002 mm)	Clay (less than 0.002 mm)	Estimated coarse fragments (Vol)
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Clegg loam:									
A11	0–2	6.7	10.7	7.6	14.3	15.3	40.1	5.3	0
A12	2–9	4.2	8.9	7.2	13.2	14.4	39.4	12.7	0
B21t	9–13	3.3	7.5	6.0	11.2	15.4	31.1	25.5	0
B22t	13–21	4.9	8.3	6.6	10.9	14.9	31.8	22.6	0
B23t	21–30	1.8	5.1	4.0	7.1	12.4	48.3	21.3	0
C1ca	30–40	2.0	6.6	6.7	11.8	12.7	38.8	21.4	10
C2ca	40–50	3.9	11.4	8.4	11.8	13.1	40.4	11.0	0
C3ca	50–66	3.0	8.6	7.7	12.1	14.6	42.2	11.8	0
Cloud Rim loam:									
A11	0–2	1.6	3.0	4.7	12.8	17.8	43.9	16.2	5
A12	2–14	2.5	2.8	4.2	11.5	17.7	42.6	18.7	5
B2t	14–54	1.0	2.0	3.1	8.9	15.4	43.8	25.8	5
B3	54–60	0.8	2.4	3.6	9.9	16.4	43.7	23.2	5
Cluff cobbly loam:									
A11	0–1	0.3	0.8	1.8	10.2	23.8	50.1	13.0	0
A12	1–9	0.4	1.2	2.5	12.9	27.9	43.9	11.2	40
A2	9–14	0.6	1.2	2.6	13.7	30.4	36.4	15.1	60
B21t	14–21	1.2	1.5	2.4	11.2	25.5	20.9	37.3	60
B22t	21–29	1.4	1.4	2.0	9.2	24.2	20.3	41.5	60
B23t	29–36	2.4	1.9	2.3	11.1	28.0	22.7	31.6	80
Crooked Creek clay loam:									
A11	0–2	1.4	4.0	4.9	11.9	11.8	37.3	28.7	0
A12	2–12	2.6	4.8	5.1	12.0	11.2	36.5	27.8	0
C1	12–23	1.2	3.4	4.7	11.9	11.6	36.4	30.8	0
C2	23–33	0.2	0.8	1.0	3.0	5.8	42.0	47.2	0
C3	33–42	0.1	0.7	1.4	9.6	17.3	36.5	34.4	0
C4	42–50	1.0	3.1	4.8	13.1	14.1	31.4	42.5	0
C5	50–70	1.3	3.4	5.3	14.1	16.9	31.6	27.4	0
Cudahy variant:									
A11	0–4	1.4	2.2	2.0	6.1	7.5	42.6	38.2	0
A12	4–9	1.3	2.0	1.7	5.0	7.2	43.5	39.3	0
C1	9–16	1.8	3.9	2.9	6.6	8.8	40.2	35.8	0
C2	16–23	0.5	1.3	1.3	4.7	10.1	44.5	37.5	0
C3	23–26	0.4	1.5	1.6	5.1	8.7	42.5	40.2	0
Daybell loam:									
A11	0–4	0.3	1.6	3.7	14.9	24.1	44.5	10.9	0
A12	4–16	0.2	1.3	3.7	16.1	25.0	44.5	9.2	0
C1	16–25	1.5	3.4	6.7	30.7	38.6	14.7	4.4	65
C2	25–31	0.7	2.6	5.9	31.0	39.7	20.1	0	65
C3	31–51	8.4	15.1	11.7	28.1	24.8	7.9	4.0	75
C4	51–60	3.6	7.5	8.3	29.2	30.3	17.1	4.0	75
C5	60–76	8.5	16.3	10.8	28.2	24.8	11.4	0	80
C6	76–90	0.8	1.9	2.6	14.9	53.7	22.9	3.2	80
Deer Creek loam:									
A11	0–3	2.6	2.2	2.5	10.6	20.4	47.2	14.5	10
A12	3–10	0.8	1.2	2.0	10.1	18.5	47.4	20.0	20
B1	10–14	1.6	1.7	2.2	9.8	16.2	40.6	27.9	30
B2t	14–34	4.1	2.9	2.5	10.3	12.3	18.4	49.5	40
C1ca	34–46	3.9	10.6	7.5	11.9	8.6	26.4	31.1	30
C2ca	46–60	1.9	9.1	8.0	12.4	9.9	28.3	30.4	20

TABLE 10.—*Mechanical analyses of representative soils*—Continued

[Analyses made in cooperative soils laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service]

Soil type and horizon	Depth from surface	Size class and diameter of particles							
		Very coarse sand (2.0–1.0 mm)	Coarse sand (2.0–1.0 mm)	Medium sand (0.5–0.25 mm)	Fine sand (0.25–0.10 mm)	Very fine sand (0.10–0.05 mm)	Silt (0.05–0.002 mm)	Clay (less than 0.002 mm)	Estimated coarse fragments (Vol)
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Flygare loam:									
A11	0–2	3.9	9.1	7.0	12.4	13.5	35.7	18.4	0
A12	2–10	8.3	14.5	7.9	11.6	9.8	33.4	14.5	0
A13	10–17	4.7	10.4	7.6	12.8	13.2	33.9	17.4	0
A14	17–27	2.8	10.0	8.0	13.0	13.5	35.4	17.3	70
A2	27–36	6.0	14.5	8.6	14.4	13.9	30.0	12.6	70
B2t	36–41	4.3	19.6	8.7	10.9	9.9	25.8	20.8	40
B3	41–50	4.3	13.9	9.0	14.2	13.8	30.2	14.6	45
C1	50–70	4.6	17.2	10.3	14.4	12.1	25.8	15.6	50
Flygare variant:									
A11	0–9	13.3	12.0	8.0	13.6	12.4	31.0	9.7	0
A12	9–26	10.3	12.8	8.9	14.8	13.1	31.1	9.0	20
A2	26–44	8.2	12.6	8.9	15.8	14.8	33.6	6.1	45
A&B	44–61	8.7	14.7	10.0	16.4	14.4	28.5	7.3	45
B2t	61–85	5.6	9.9	8.7	17.2	14.5	27.9	16.2	45
Gappmayer gravelly fine sandy loam:									
A11	0–2	3.5	4.6	4.8	15.9	18.6	34.1	18.5	20
A12	2–11	9.3	6.9	5.7	21.4	15.9	28.7	12.1	30
A21	11–21	6.4	6.0	6.1	25.1	16.7	27.7	12.0	30
A22	21–28	9.4	6.6	5.1	18.7	16.6	29.2	14.4	40
B2t	28–33	4.2	8.1	6.9	21.1	21.7	13.7	24.3	65
Hailman loam:									
A11	0–5	4.1	8.8	5.7	9.3	12.6	43.2	16.3	0
A12	5–15	6.3	9.1	5.6	9.2	12.7	40.8	16.3	0
A13	15–26	7.0	9.8	5.9	9.2	12.1	40.2	15.8	30
A3	26–33	4.0	8.8	6.4	10.1	13.7	42.3	14.7	40
B21	33–43	5.0	10.5	7.7	12.4	14.4	35.0	15.0	45
B22	43–57	5.2	11.7	8.3	13.0	15.2	34.1	12.5	45
Henefer silt loam:									
A11	0–3	0	0.5	0.9	4.3	15.7	63.6	15.0	0
A12	3–12	0.1	0.3	0.7	3.9	17.3	62.5	15.2	0
B1	12–20	0.2	0.2	0.4	2.3	14.6	59.6	22.7	20
B21t	20–36	0	0.2	0.5	4.0	15.1	36.8	43.4	25
B22t	36–48	0.6	1.1	1.3	5.3	16.8	28.4	46.5	75
B3	48–60	0.4	1.7	2.5	9.8	26.8	30.0	28.8	80
Holmes gravelly loam:									
Ap	0–2	2.8	7.1	4.1	7.3	17.1	42.6	19.0	30
A12	2–11	3.3	5.3	3.9	8.6	17.4	43.5	18.0	30
B2t	11–21	4.4	5.4	4.1	8.9	15.3	39.5	22.4	50
B3	21–38	12.3	16.5	12.2	18.3	12.1	13.0	15.6	65
C	38–60	19.7	18.3	14.6	21.7	11.3	6.8	7.6	80
Horrocks very cobbly sandy clay loam:									
A1	0–5	7.9	11.5	7.9	13.7	11.8	25.1	22.1	50
A21t	5–14	7.8	11.1	7.4	12.7	11.3	20.5	29.2	60
B22t	14–27	8.1	12.2	7.7	13.8	11.1	20.5	26.6	65
C1	27–41	8.8	15.5	9.6	15.6	13.3	23.3	13.9	65
Kovich loam:									
A11	0–1	0.4	1.9	4.9	19.2	19.7	35.2	18.7	0
A12	1–11	0.3	1.9	5.3	19.3	20.5	34.8	17.9	0
A13	11–24	0.5	2.0	5.6	19.1	16.4	32.8	23.6	0
A14	24–29	0.7	2.8	8.2	22.9	15.4	28.6	21.4	0
IIC1	29–41	2.3	7.6	12.5	23.3	13.4	20.0	20.9	75

TABLE 10.—*Mechanical analyses of representative soils*—Continued

[Analyses made in cooperative soils laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service]

Soil type and horizon	Depth from surface	Size class and diameter of particles							
		Very coarse sand (2.0–1.0 mm)	Coarse sand (2.0–1.0 mm)	Medium sand (0.5–0.25 mm)	Fine sand (0.25–0.10 mm)	Very fine sand (0.10–0.05 mm)	Silt (0.05–0.002 mm)	Clay (less than 0.002 mm)	Estimated coarse fragments (Vol)
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Kovich deep water table variant:									
A1p	0–5	0.2	0.4	0.7	6.3	22.7	49.3	20.4	0
A12	5–16	0.2	0.3	0.7	6.0	22.0	48.9	21.0	0
C1	16–27	0.2	0.5	0.7	4.7	21.7	52.7	19.5	0
C2	27–39	1.3	2.1	2.5	10.7	30.2	38.1	15.1	0
C3	39–60	3.8	4.3	3.4	13.3	27.4	30.4	17.4	0
Lake Janee cobbly sandy loam:									
A1	0–2	9.4	15.2	8.7	13.0	12.2	29.6	11.9	25
B21	2–14	5.7	14.8	9.4	13.8	11.5	32.6	12.2	20
B22	14–24	6.0	16.1	11.3	16.6	13.1	25.2	11.7	30
B23	24–36	9.5	18.2	10.6	16.3	13.0	19.6	12.8	30
B24	36–48	4.8	16.4	11.9	19.0	14.3	21.2	12.4	35
B25	48–66	5.8	17.7	12.6	19.6	13.5	18.4	12.5	35
C	66–80	12.3	20.1	10.8	15.5	12.4	19.3	9.6	35
Little Pole very cobbly sandy clay loam:									
A1	0–5	3.2	8.9	8.1	13.7	11.1	25.8	29.2	50
A3	5–10	4.9	9.9	7.9	12.8	11.4	23.6	29.5	40
B2	10–16	6.1	9.9	7.8	13.9	13.3	23.5	25.5	50
Logan variant:									
A11	0–2	0.0	0.2	0.5	1.7	4.6	50.7	42.3	0
A12	2–10	0.1	0.4	0.9	3.1	4.6	44.7	46.2	0
C1ca	10–16	1.1	0.4	0.8	3.3	5.4	41.1	47.9	0
C2ca	16–23	0.7	2.5	3.5	12.1	13.1	41.7	24.4	0
C3	23–29	0.6	1.6	2.6	11.9	17.2	43.7	22.4	0
C4	29–35	2.1	3.3	4.1	15.9	20.5	36.4	17.7	25
Manila silt loam:									
Ap	0–10	0.0	0.1	0.3	1.5	9.2	66.0	22.9	0
A12	10–18	0.5	1.1	1.2	3.3	14.9	53.3	25.7	0
B1	18–26	0.3	0.8	0.8	2.4	12.8	53.4	29.6	0
B21t	26–35	0.0	0.1	0.2	1.3	13.0	51.5	33.9	0
B22t	35–50	0.1	0.3	0.3	1.5	11.9	47.4	38.5	0
B31	50–72	0.1	0.4	0.4	1.7	11.3	48.3	37.8	0
B32	72–97	0.2	0.4	0.4	1.8	10.6	52.8	33.8	0
McPhie fine sandy loam:									
A11	0–3	3.0	12.0	12.0	21.8	15.5	24.1	11.6	0
A12	3–13	1.4	10.8	12.6	24.4	16.8	21.8	12.2	0
A2	13–28	3.0	13.1	13.0	24.4	17.3	22.0	7.2	0
B&A	28–37	2.6	10.8	10.4	18.7	15.0	29.9	12.6	30
B2t	37–54	3.4	12.6	11.0	20.9	16.0	25.2	10.9	30
B3	54–64	4.3	13.5	11.8	21.0	15.8	22.4	11.2	30
C	64–78	8.3	24.2	16.1	25.0	12.2	10.2	4.0	80
Mult variant:									
A11	0–4	4.7	5.6	3.6	8.9	13.2	40.2	23.8	10
A12	4–16	6.2	7.5	4.5	10.3	13.2	32.2	26.1	5
B&A	16–18	4.7	6.5	4.7	12.3	13.8	28.5	29.5	10
B2t	18–32	5.1	7.0	5.5	14.8	15.5	22.6	29.5	10
B3	32–70	17.1	18.2	9.1	13.1	9.3	16.6	16.6	35
Poleline gravelly loam:									
A11	0–8	6.3	6.8	3.1	6.3	13.3	47.9	16.3	45
A12	8–20	4.6	6.9	3.8	7.6	14.5	43.4	19.2	45
A13	20–32	3.9	6.3	3.6	8.5	16.4	42.8	18.5	50
B2	32–44	6.4	12.3	6.9	11.7	15.9	34.9	11.9	50

TABLE 10.—*Mechanical analyses of representative soils*—Continued

[Analyses made in cooperative soils laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service]

Soil type and horizon	Depth from surface	Size class and diameter of particles							
		Very coarse sand (2.0–1.0 mm)	Coarse sand (2.0–1.0 mm)	Medium sand (0.5–0.25 mm)	Fine sand (0.25–0.10 mm)	Very fine sand (0.10–0.05 mm)	Silt (0.05–0.002 mm)	Clay (less than 0.002 mm)	Estimated coarse fragments (Vol)
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Rasband loam:									
Ap	0–5	0.4	2.4	4.4	19.4	23.6	40.0	9.8	10
B1	5–12	2.0	4.6	5.8	14.9	18.3	37.2	17.2	0
B21t	12–24	3.4	5.6	5.3	12.7	14.9	32.7	25.4	20
B22t	24–30	5.0	6.5	5.3	13.6	16.4	32.3	20.9	25
B3	30–36	15.7	17.2	10.2	16.1	12.0	19.6	9.2	40
C	36–60	18.7	19.1	18.6	16.6	12.4	13.0	1.6	70
Roundy loam:									
A11	0–2	0.6	1.8	2.9	12.7	25.1	43.4	13.5	0
A12	2–16	1.2	2.0	2.5	11.2	28.0	46.8	8.3	0
A13	16–24	1.8	2.5	2.7	10.8	29.3	48.5	4.4	60
A2	24–31	0.8	1.3	2.3	10.9	34.9	45.0	4.8	60
B21t	31–48	0.3	0.6	0.6	3.2	20.8	17.9	56.6	20
Sessions clay loam:									
A11	0–3	1.4	2.5	3.6	12.6	17.8	33.5	28.6	10
A12	3–13	1.4	2.4	3.4	12.5	17.6	32.1	30.6	20
B21t	13–35	1.2	2.2	3.4	12.1	15.5	25.3	40.3	15
B22t	35–54	2.6	2.6	3.2	11.2	15.5	26.5	38.4	25
B3	54–61	3.3	4.2	5.2	18.6	21.8	23.5	23.4	30
Spaa silt loam:									
Ap	0–8	1.3	1.8	1.2	2.8	9.5	56.6	26.8	0
A12	8–15	2.5	2.6	1.5	2.8	9.6	59.1	21.9	0
C1	15–17	4.3	7.1	4.5	6.0	8.9	46.8	22.4	0
Van Wagoner cobbly sandy loam:									
A11	0–1	1.6	12.3	11.7	20.3	19.5	28.3	6.3	15
A12	1–15	3.0	13.8	13.4	21.1	16.6	25.2	6.9	20
C	15–20	1.5	12.6	15.1	24.7	16.5	21.1	8.5	60
Wallsburg very cobbly sandy clay loam:									
A11	0–2	0.7	2.8	5.0	23.8	27.7	27.2	12.8	65
A12	2–8	0.6	2.1	4.3	20.5	25.2	23.9	23.4	65
B21t	8–12	0.5	1.3	2.5	13.3	19.3	25.6	25.9	65
Watkins Ridge silt loam:									
A11	0–2	0.5	0.9	1.0	4.0	16.7	54.4	22.5	0
A12	2–12	0.9	1.3	1.4	4.6	15.9	48.1	27.8	30
C1ca	12–20	1.7	4.8	3.5	6.5	12.1	39.1	32.3	30
C2ca	20–34	4.3	9.4	7.4	11.5	11.5	31.0	24.9	0
C3ca	34–46	4.2	12.5	9.2	13.2	12.5	28.1	20.3	0
C4ca	46–60	1.5	5.3	5.5	10.3	13.5	36.8	27.1	0
Whipstock cobbly loam:									
A11	0–2	0.7	1.8	2.4	8.9	17.3	44.6	24.3	35
A12	2–10	0.9	1.5	2.3	8.9	17.6	42.8	26.0	35
A3	10–21	1.2	1.5	2.1	8.7	17.2	40.1	29.2	35
B21t	21–37	0.6	0.7	1.3	6.4	8.9	18.2	63.9	20
B22t	37–49	0.7	0.9	1.2	4.9	7.5	18.9	65.9	25
B23tca	49–59	2.2	1.8	2.0	7.2	9.7	20.9	56.2	40
Cca	59–69	2.3	2.7	3.1	9.8	10.8	23.3	48.0	70

nal standard. Potassium was measured for the same extract by the same method.

The percent base saturation was determined by dividing the sum of the extractable bases by the cation-exchange capacity and multiplying the result by 100. Table 11 gives the data for sodium and potassium only. The other four were determined but not reported.

The results of the mechanical analysis of samples of representative soils of the survey area are given in table 10. The coarse fragments were estimated as percent by volume. The results of chemical analysis of the same soils are given in table 11.

TABLE 11.—*Chemical analyses of representative soils*

[Analyses made at Cooperative Soils Laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service. Dashes indicate no determinations were made]

Soil type and horizon	Depth from surface	Reaction, saturated paste	Organic matter			Electrical conductivity ($EC \times 10^3$)	$CaCO_3$ equivalent	Cation exchange capacity	Exchangeable sodium and potassium		Base saturation
			Total organic matter	Nitrogen	C/N ratio				Na	K	
	Inches	*pH*	*Percent*	*Percent*		*Mmhos/cm at °25 C*	*Percent*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Percent*
Baird Hollow loam:											
A11	0–5	6.4	11.01	0.438	14.6	0.8		33.3	0.10	2.09	70
A12	5–22	5.9	6.21	.269	13.4	.7		27.4	.07	1.08	59
A&B	22–29	5.7	.67	.037	10.5	.3		17.6	.13	.55	75
B21t	29–38	5.3	.57	.034	9.7	.2		27.0	.29	.65	76
B22t	38–55	4.9	.62			.1		30.7	.28	.56	76
B23t	55–72	4.9	.48			.1		35.9	.35	.46	81
Bezzant very cobbly loam:											
A11	0–2	7.4	4.27	.211	11.8	1.72	15.4	27.3	.25	.67	100
A12	2–10	7.3	3.27	.174	10.9	1.10	12.0	28.2	.21	1.46	100
AC	10–16	7.3	2.72	.154	10.3	.98	20.0	25.6	.37	.74	100
C1ca	16–25	7.3	2.06	.125	9.6	1.21	34.6	23.3	.29	.43	100
C2ca	25–60	7.5	1.01	.051	11.6	.97	46.1	19.1	.32	.25	100
Bradshaw very cobbly very fine sandy loam:											
A11	0–3	7.5	2.37	.113	12.2	.60		14.1	.20	.68	100
A12	3–11	7.5	2.10	.112	10.9	.62		16.2	.03	.49	100
B2	11–29	7.5	.98	.055	10.4	.46		15.3	.08	.38	100
C1	29–40	7.5	1.10	.057	11.2	.62	2.3	16.6	.07	.39	100
C2	40–62	7.6	.79	.043	10.7	.52		17.0	.07	.39	100
Broadhead very cobbly loam:											
A11	0–5	6.7	4.49	.186	14.0	.3		20.4	.25	1.32	88
A12	5–12	6.6	2.25	.108	12.1	.6		19.0	.33	1.22	90
B21t	12–22	6.5	1.10			.3		32.0	.38	1.09	89
B22t	22–34	6.6	.86			.3		29.8	.44	.93	91
B3	34–44	6.6	.58			.3		25.3	50	.85	94
C1	44–60	6.8	.58			.4		28.6	.65	.73	94
Buell gravelly loam:											
A11	0–5	5.7	9.27	.371	14.5	0.4		28.4	0.27	1.20	47
A12	5–15	5.7	5.23	.226	13.5	.2		22.6	0.27	1.05	37
A13	15–29	5.6	4.02	.181	12.9	.2		21.3	.27	.59	32
B21	29–56	5.4	1.48			.2		13.7	.27	.34	46
B22	56–60	5.7	.48	.026	10.8	.30		15.1	.13	.22	
B23	60–62+	5.1	.52	.032	9.4	.36		15.8	.15	.22	
Burgi gravelly loam:											
A11	0–2	6.6	7.84	.244	18.7	.6		29.7	.22	1.30	80
A12	2–12	6.7	1.72	.077	13.0	.5		16.0	.19	.66	83
A13	12–26	7.0	1.10	.060	10.7	.5		15.1	.18	.52	91
C1	26–39	7.3	1.24			.6	3.8	15.0		.35	
C2	39–60	7.4	1.79			.6	6.6	15.3		.35	
Center Creek loam:											
Ap	0–5	6.9	7.12	.372	11.1	1.98	.3	26.0	.30	1.03	
A12	5–12	7.6	2.20	.104	12.3	1.53	.2	18.5	.26	1.24	
B1	12–20	7.5	1.20	.068	10.3	.77	.2	20.6	.38	.89	
B2t	20–33	7.5	.86	.050	10.0	.52	.3	25.2	.43	.66	
B3	33–40	7.4	.55	.037	8.6	.44	.2	17.9	.40	.50	
C1	40–50	7.5	.43	.028	11.7	.45	.3	14.4	.11	.40	
C2	50–60	7.8	.62	.038	9.5	.40	6.3	13.2	.19	.28	

TABLE 11.—*Chemical analyses of representative soils*—Continued

[Analyses made at Cooperative Soils Laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service. Dashes indicate no determinations were made]

Soil type and horizon	Depth from surface	Reaction, saturated paste	Organic matter			Electrical conductivity ($EC \times 10^3$)	$CaCO_3$ equivalent	Cation exchange capacity	Exchangeable sodium and potassium		Base saturation
			Total organic matter	Nitrogen	C/N ratio				Na	K	
	Inches	*pH*	*Percent*	*Percent*		*Mmhos/cm at °25 C*	*Percent*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Percent*
Clayburn loam:											
A11	0–2	6.2	9.98	0.351	16.5	0.5		30.6	0.30	1.49	70
A12	2–12	6.4	4.58	.174	15.3	.4		28.2	.25	1.99	74
A13	12–18	6.4	2.77	.121	13.3	.4		23.4	.26	2.03	80
B1	18–24	6.3	1.75	.098	10.4	.4		22.0	.28	1.52	83
B21t	24–36	6.2	1.08	.065	9.7	.2		31.6	.27	1.20	80
B22t	36–41	6.2	1.24			.2		30.7	.30	.82	77
C1	41–48	6.4	.72			.2		16.3	.26	.57	84
C2	48–60	6.6	.55			.3		15.9	.26	.60	77
Clegg loam:											
A11	0–2	6.8	2.73	.116	13.7	.9		15.0	.35	.86	89
A12	2–9	6.5	2.15	.106	11.8	1.0		19.5	.32	.77	90
B21t	9–13	6.5	1.10	.059	10.8	1.0		21.5	.32	.59	89
B22t	13–21	6.6	.77	.048	9.4	.6		21.9	.35	.46	91
B23t	21–30	6.7	1.00			.5		23.4	.41	.51	90
C1ca	30–40	7.5				1.1	26.3	16.1	.33	.33	
C2ca	40–50	7.7	.91			1.3	37.3	15.9	.46	.32	
C3ca	50–66	7.7	.41			1.3	21.6	19.2	.65	.33	
Cloud Rim loam:											
A11	0–2	6.8	3.51	.139	14.7	0.87		18.2	0.08	1.04	83
A12	2–14	6.7	1.93	.092	12.2	.59		15.0	.13	.99	89
B2t	14–54	6.5	.50	.040	7.3	.23		14.1	.12	1.15	79
B3	54–60	6.5	.45	.035	7.4	.25		12.5	.12	.92	85
Cluff cobbly loam:											
A11	0–1	6.5	32.07	1.017	18.7	.82		78.2	.27	1.03	77
A12	1–9	5.8	3.65	.114	18.6	.53		16.4	.12	.37	62
A2	9–14	5.7	1.43	.059	14.1	.52		14.0	.17	.37	78
B21t	14–21	5.0	1.17	.055	12.4	.25		35.8	.17	.41	79
B22t	21–29	4.9	.84	.036	13.6	.18		33.2	.18	.31	76
B23t	29–36	4.5	.57	.027	12.2	.19		32.2	.19	.40	75
Crooked Creek clay loam:											
A11	0–2	7.6	11.97	.665	10.5	2.40	2.6	39.8	1.42	2.53	
A12	2–12	7.9	5.40	.280	11.2	3.0	6.5	30.9	1.75	.86	
C1	12–23	7.4	1.44	.072	11.7	1.5	.2	32.1	.32	.87	
C2	23–33	7.0	1.91	.100	11.1	.80	.2	41.4	.45	1.24	
C3	33–42	7.1	.62	.038	9.5	.50	.2	33.1	.57	1.03	
C4	42–50	7.0	.57	.037	8.9	.67	.2	34.1	.52	1.05	
C5	50–70	7.4	.41	.024	10.0	.60	.1	27.7	.42	.76	
Cudahy variant:											
A11	0–4	8.1	9.20	.517	10.3	.97	46.7	32.1	1.76	1.21	
A12	4–9	7.9	9.51	.490	11.3	1.3	53.6	30.3	1.84	.78	
C1	9–16	8.1	8.41	.445	11.0	1.8	49.1	25.7	2.06	.58	
C2	16–23	8.0	4.01	.207	11.2	1.5	60.9	14.5	1.82	.52	
C3	23–26	8.0	2.94	.146	11.7	.98	55.8	13.5	1.54	.41	
Daybell loam:											
A11	0–4	6.7	12.04	.393	17.8	1.00		29.4	.4	1.51	
A12	4–16	6.8	3.34	.126	15.3	.47		17.4	.2	.59	
C1	16–25	6.8	.88	.029	17.6	.40		4.8	.2		
C2	25–31	6.8	.65			.31		3.3	.2		
C3	31–51	6.8	.58			.38		3.4	.2	.14	
C4	51–60	6.8	.55			.37		3.3	.2	.17	
C5	60–76	7.0	.29			.30		2.5	.2		
C6	76–90	7.0	.64			.58		6.7	.2		

TABLE 11.—*Chemical analyses of representative soils*—Continued

[Analyses made at Cooperative Soils Laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service. Dashes indicate no determinations were made]

Soil type and horizon	Depth from surface	Reaction, saturated paste	Organic matter			Electrical conductivity ($EC \times 10^3$)	$CaCO_3$ equivalent	Cation exchange capacity	Exchangeable sodium and potassium		Base saturation
			Total organic matter	Nitrogen	C/N ratio				Na	K	
	Inches	*pH*	*Percent*	*Percent*		*Mmhos/cm at °25 C*	*Percent*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Percent*
Deer Creek loam:											
A11	0–3	7.0	3.40	0.158	12.5	0.78	----	12.8	0.06	1.12	100
A112	3–10	6.8	2.25	.127	10.3	.57	----	17.6	.01	1.01	87
B1	10–14	6.7	1.48	.099	8.7	.53	----	24.6	.06	1.21	88
B2t	14–34	6.4	1.15	.078	8.6	.30	----	43.5	.52	1.17	87
C1ca	34–46	7.5	----	----	----	.47	45.5	15.6	.37	.41	100
C2ca	46–60	7.7	----	----	----	.46	66.6	11.2	.30	.24	100
Flygare loam:											
A11	0–2	6.4	8.03	.304	15.4	.74	----	27.3	.77	2.38	73
A12	2–10	6.0	3.29	.139	13.7	.42	----	20.4	.77	1.09	67
A13	10–17	5.6	2.77	.126	12.8	.46	----	19.8	.78	.79	62
A14	17–27	5.6	2.60	.123	12.3	.29	----	18.3	.79	.68	61
A2	27–36	5.7	1.03	.042	14.3	.31	----	14.4	.66	.50	67
B2t	36–41	5.1	.72	----	----	.23	----	22.5	.10	.45	72
B3	41–50	5.3	.43	----	----	.24	----	17.8	.10	.25	73
C1	50–70	5.4	.24	----	----	.21	----	18.3	.09	.23	76
Flygare variant:											
A11	0–9	5.9	10.3	.288	20.8	.81	----	29.8	.03	1.07	68
A12	9–26	5.9	2.05	.097	12.3	.51	----	17.9	.13	.90	73
A2	26–44	6.1	.96	.040	14.0	.40	----	13.9	.15	.54	79
A&B	44–61	5.9	.62	.025	14.4	.28	----	13.8	.09	.55	81
B2t	61–85	5.8	.52	.026	11.5	.29	----	24.2	.14	1.12	84
Gappmayer gravelly fine sandy loam:											
A11	0–2	6.8	7.77	.247	18.3	.7	----	23.6	.10	1.01	80
A12	2–11	6.8	2.79	.101	16.0	.7	----	15.2	.16	.84	80
A21	11–21	6.9	.86	.034	14.7	.6	----	9.2	.25	.63	87
A22	21–28	6.7	.71	.039	10.5	.4	----	10.4	.13	.65	86
B2t	28–33	6.5	.93	----	----	.4	----	17.7	.22	.96	89
Hailman loam:											
A11	0–5	5.7	14.0	.547	14.9	.52	----	41.1	.31	1.19	59
A12	5–15	5.8	4.66	.196	13.8	.26	----	26.6	.27	.87	52
A13	15–26	6.0	3.30	.140	13.7	.25	----	21.7	.26	.87	52
A3	26–33	5.7	2.34	.127	10.7	.36	----	19.7	.14	.63	71
B21	33–43	6.1	.81	.043	10.9	.36	----	15.8	.29	.47	74
B22	43–57	6.1	.65	----	----	.22	----	16.9	.25	.33	73
Henefer silt loam:											
A11	0–3	6.6	6.07	.269	13.1	.9	----	24.4	.20	1.37	78
A12	3–12	6.3	4.97	.227	12.7	.5	----	22.5	.27	1.08	74
B1	12–20	6.2	.89	.058	9.0	.3	----	16.4	.26	.83	77
B21t	20–36	6.0	1.19	----	----	.3	----	30.7	.36	.92	79
B22t	36–48	6.7	1.00	----	----	.8	----	29.6	.36	.77	93
B3	48–60	7.0	----	----	----	.7	----	22.2	.34	.56	88
Holmes gravelly loam:											
Ap	0–2	6.9	6.05	.296	11.9	1.15	----	20.5	.09	1.02	95
A12	2–11	6.9	2.51	.137	10.7	.56	----	16.9	.06	.69	86
B2t	11–21	6.7	1.14	.078	8.5	.43	----	14.9	.04	.65	83
B3	21–28	6.6	.72	.045	9.3	.49	----	8.7	.18	.28	81
C1	28–60	6.5	----	----	----	.37	----	4.8	.04	.18	85
Horrocks very cobbly sandy clay loam:											
A1	0–5	6.8	9.00	.332	15.8	1.01	.4	34.3	.27	.93	91
B21t	5–14	6.6	2.32	.107	12.6	.63	----	32.3	.13	.91	90
B22t	14–27	6.3	1.00	.062	9.4	.54	----	35.7	.40	.58	88
C1	27–41	6.6	2.48	.026	10.8	.38	----	31.1	.44	.41	92

TABLE 11.—*Chemical analyses of representative soils*—Continued

[Analyses made at Cooperative Soils Laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service. Dashes indicate no determinations were made]

Soil type and horizon	Depth from surface	Reaction, saturated paste	Organic matter			Electrical conductivity (EC × 10^3)	$CaCO_3$ equivalent	Cation exchange capacity	Exchangeable sodium and potassium		Base saturation
			Total organic matter	Nitrogen	C/N ratio				Na	K	
	Inches	*pH*	*Percent*	*Percent*		*Mmhos/cm at °25 C*	*Percent*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Percent*
Kovich loam:											
A11	0–1	6.5	19.0	0.805	13.7	0.85	0.3				
A12	1–11	6.5	4.47	.219	11.9	.46	.1				
A13	11–24	6.4	2.17	.109	11.6	.36	.1				
A14	24–29	6.5	1.03	.056	10.7	.45	.2	23.9			
IIC1	29–41	6.7	1.24	.069	10.4	.67	.4	22.0			
Kovich deep water table variant:											
A1p	0–5	6.9	6.90	.326	12.3	1.74	1.0	30.5	.40	1.59	
A12	5–16	7.3	5.38	.270	11.6	1.10	1.0	28.4	.32	1.13	
C1	16–27	7.3	2.00	.111	10.4	1.69	4.0	21.9	.43	.54	
C2	27–39		1.26	.065	11.2			16.9	.30	.68	
C3	39–60		.71	.059	8.2			14.1	.24	.64	
Lake Janee cobbly sandy loam:											
A1	0–2	6.1	4.15	.101	23.9	.5		19.1	.3	.61	58
B21	2–14	5.8	1.87	.050	21.8	.3		17.1	.2	.45	48
B22	14–24	5.9	1.12	.031	21.0	.2		15.0	.2	.29	43
B23	24–36	5.9	.77	.022	21.4	.2		13.6	.2	.25	40
B24	36–48	5.9	.69			.4		12.0	.2	.23	36
B25	48–66	5.9	.72			.2		12.4	.3	.25	36
CR	66–80	6.0	.48			.3		9.7	.2	.24	
Little Pole very cobbly sandy clay loam:											
A1	0–5	6.7	2.44	.130	10.9	.52		26.5	.20	1.97	97
A3	5–10	6.7	1.38	.075	10.7	.53		30.2	.18	1.33	90
B2	10–16	6.8	.83	.052	9.2	.46		37.1	.20	1.26	94
Logan variant:											
A11	0–2	7.6	21.3	.866	14.3	2.9	12.7	62.0	.36	1.27	115
A12	2–10	7.7	8.74	.400	12.7	1.9	35.7	44.6	.33	.61	78
C1ca	10–16	7.8	3.78	.272	8.1	1.1	53.3	26.6	.28	.50	68
C2ca	16–23	7.8	1.78	.079	13.0	.7	22.0	23.0	.17	.78	66
C3	23–29	7.6	.93	.047	11.5	.6	1.5	30.7	.21	.89	61
C4	29–35	7.6	.78	.037	12.2	.6	.5	21.8	.17	.64	48
Manila silt loam:											
Ap	0–10	6.9	3.90	.201	11.4	1.03		23.7	.14	.75	
A12	10–18	7.2	1.44	.086	9.8	.54		20.0	.15	.72	
B1	18–26	7.0	.99			.42		19.9	.15	.67	
B21t	26–35	6.7	.79			.31		22.7	.16	.58	
B22t	35–50	7.1	.74			.26		29.6	.20	.56	
B31	50–72	7.1	.34			.40		30.1	.26	.67	
B32	72–97	7.3	.29			.43	.6	27.1	.26	.64	
McPhie fine sandy loam:											
A11	0–3	6.2	11.87	.372	18.6	.79		32.7	.11	.70	74
A12	3–13	6.1	5.40	.201	15.6	.53		25.1	.12	.47	73
A2	13–28	6.1	.89	.038	13.7	.53		12.0	.29	.21	77
B&A	28–37	6.0	.77	.038	11.8	.29		22.8	.32	.24	83
B2t	37–54	6.0	.31	.027	6.7	.35		20.4	.27	.20	82
B3	54–64	6.1	.29	.011	15.5	.29		19.1	.31	.21	88
C1	64–78	6.3	.24	.010	14.0	.43		12.5	.29	.13	87
Mult variant:											
A11	0–4	6.2	17.7	.68	15.1	1.14		49.7	.12	1.59	80
A12	4–16	6.0	5.95	.26	13.3	.38		36.9	.10	1.48	78
B&A	16–18	5.8	3.65	.14	15.1	.29		32.0	.11	1.21	80
B2t	18–32	5.6	.86			.24		31.0	.14	.93	88
B3	32–70	6.6	.60			.57	.6	21.0	.11	.59	94

TABLE 11.—*Chemical analyses of representative soils*—Continued

[Analyses made at Cooperative Soils Laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service. Dashes indicate no determinations were made]

Soil type and horizon	Depth from surface	Reaction, saturated paste	Organic matter			Electrical conductivity (EC × 10^3)	$CaCO_3$ equivalent	Cation exchange capacity	Exchangeable sodium and potassium		Base saturation
			Total organic matter	Nitrogen	C/N ratio				Na	K	
	Inches	*pH*	*Percent*	*Percent*		*Mmhos/cm at 25° C*	*Percent*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Percent*
Poleline gravelly loam:											
A11	0–8	6.5	15.5	0.55	16.4	1.14		39.9	0.09	1.26	76
A12	8–20	6.2	5.76	.24	13.9	.43		25.2	.10	.91	63
A13	20–32	6.1	3.65			.30		20.4	.09	.75	61
B2	32–44	6.1	1.03			.27		9.9	.04	.43	63
Rasband loam:											
Ap	0–5	7.1	6.40	.286	13.0	1.53		19.4	.08	.58	
B1	5–12	6.9	2.00	.095	12.2	.56		18.0	.13	.54	
B21t	12–24	6.7	.89	.052	10.0	.35		24.6	.20	.74	
B22t	24–30	6.5	.76			.31		21.2	.24	.62	
B3	30–36	7.2	.79			.32		14.3	.04	.47	
C1	36–60	7.0	.31			.46		10.2	.22	.41	92
Rasband coarse sandy loam:											
A11	0–2	6.4	5.38	.231	13.5	.85		25.3	.25	1.75	85
A12	2–6	6.7	2.49	.122	11.9	.50		24.5	.32	1.41	81
B2t	6–18	6.5	2.24	.109	11.9	.55		27.8	.27	1.20	86
B3	18–30	6.8	1.36	.074	10.7	.81		19.2	.26	.61	88
C1	30–46	7.0	.86	.053	9.4	.45		16.1	.30	.50	
C2	46–60	7.1	.77	.046	9.8	.40		18.8	.35	.38	
Roundy loam:											
A11	0–2	6.7	13.0	.516	14.6	1.10		31.8	.2	1.40	78
A12	2–16	6.9	4.87	.221	12.8	.59		21.5	.5	.94	73
A13	16–24	6.9	1.57	.067	13.6	.50		10.7	.2	.50	79
A2	24–31	7.2				.45		.68	.2	.30	88
B21t	31–48	5.6				.27		43.2	.3	1.27	80
Sessions clay loam:											
A11	0–3	6.3	5.71	.292	11.4	.68		33.8	.3	1.48	70
A12	3–13	7.1	3.65	.189	11.2	.58		33.8	.2	.70	73
B21t	13–35	6.2	1.01	.050	11.8	.38		45.9	.3	.50	88
B22t	35–54	6.5	.74			.30		41.7	.4	.48	86
B3	54–61	7.4	.55			.55		27.7	.3	.40	92
Spaa silt loam:											
Ap	0–8		5.43	.282	11.2	2.55	7.0	33.8	.21	1.04	95
A12	8–15		2.55	.136	10.9	.99	11.3	29.3	.23	.65	
C1	15–17		2.27	.128	10.3		27.7	25.0			
Van Wagoner cobbly sandy loam:											
A11	0–1	6.5	4.83	.207	13.6	.97		24.6	.48	.46	85
A12	1–15	6.8	1.93	.079	14.2	1.03		19.5	.30	1.33	88
C	15–20	6.6	.74	.035	12.3	.77		17.9	.35	1.13	90
Wallsburg very cobbly sandy clay loam:											
A11	0–2	7.1	2.44	.112	12.7	.8		16.8	.20	1.17	
A12	2–8	7.1	2.10	.104	11.7	.6		20.1	.20	1.06	
B21t	8–12	7.0	1.62	.092	10.2	.5		28.0	.21	1.10	
Watkins Ridge silt loam:											
A11	0–4	7.5	5.31	.249	12.4	.7		28.6	.20	1.94	
A12	4–12	7.4	3.89	.210	10.8	.8	1.3	28.9	.21	.87	
C1ca	12–20	7.6	2.60	.151	10.0	.6	35.0	25.1	.24	.40	
C2ca	20–34	7.7	.96			.4	38.8	11.7	.18	.22	
C3ca	34–46	7.9	.52			.4	72.3	12.4	.22	.22	
C4ca	46–60	7.6				.5	41.9	23.8	.33	.46	

TABLE 11.—*Chemical analyses of representative soils*—Continued

[Analyses made at Cooperative Soils Laboratory at Utah State University, Logan, under the direction of James P. Thorne, Soil Conservation Service. Dashes indicate no determinations were made]

Soil type and horizon	Depth from surface	Reaction, saturated paste	Organic matter			Electrical conductivity (EC × 10^3)	$CaCO_3$ equivalent	Cation exchange capacity	Exchangeable sodium and potassium		Base saturation
			Total organic matter	Nitrogen	C/N ratio				Na	K	
	Inches	*pH*	*Percent*	*Percent*		*Mmhos/cm at °25 C*	*Percent*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Meq/100 gm of soil*	*Percent*
Whipstock cobbly loam:											
A11	0–2	6.9	7.14	0.320	13.0	0.88	--------	29.2	0.12	1.45	86
A12	2–10	6.4	4.23	.195	12.6	.36	--------	27.2	.12	.85	79
A3	10–21	6.3	2.06	.111	10.8	.36	--------	25.9	.13	.75	79
B21t	21–37	6.2	.72	.044	9.5	.25	--------	69.0	.30	.42	84
B22t	37–49	7.3	.95	--------	--------	.36	13.8	67.4	.39	.42	--------
B23tca	49–59	7.3	.74	--------	--------	.36	17.5	57.7	.29	.44	--------
Cca	59–69	7.5	.76	--------	--------	.37	31.2	44.8	.24	.44	--------

Environmental Features

In this section mainly the climate, physiography, and drainage of the survey area are described. Information also is provided about water supply, settlement and population, industry, farming and livestock, and urbanization of the area.

Climate[5]

The Heber Valley Area, consisting of mountain valley and the surrounding higher areas of mountains, has a very wide variation in climate. The floor of the valley averages just over a mile above sea level; however, some 15 miles to the west, the Wasatch Mountains tower more than a mile higher. The valley has two main drainageways and several minor ones, but the only outlet is through the relatively narrow Provo Canyon. The remainder of the area is composed of the encircling mountains that have fairly steep slopes.

The climate of this Area is continental. It features low humidity, abundant sunshine all year except in winter and early in spring, relatively light precipitation, and wide ranges in annual temperature. Climatic data for the Area are given in tables 12 and 13.

The topographic features result in the formation of a pronounced temperature inversion during most seasons of the year, because the cold air flows down the mountain slopes and collects on the floor of the valley below. This inversion causes the average temperature on the slopes 1,000 to 1,500 feet above the valley floor to be several degrees higher than temperatures either above or below this level. The growing season on the valley floor is very short, averaging generally between June 19 and September 4.

Summer temperatures are cool and pleasant. A maximum temperature of 100° F is recorded during only about 1 out of 10 years. During the warmest month (July) maximum temperatures are generally in the middle eighties and the minimum in the middle forties.

Winter temperatures are very cold. The January average minimum on the valley floor is only 6° F and the maximum is in the middle thirties. Tables are given for the average conditions at Heber and Snake Creek Power House, which are both in the lower part of the area. No data are available for the conditions near the inversion top and higher. The bulk of the precipitation is received during the period October to May, when low-pressure storms from the Pacific Ocean frequent the region. Amounts range from as low as 15 inches a year near the valley floor to between 25 and 36 inches on some of the higher mountain slopes. On an average, the heaviest amounts occur during December and January, but there is a secondary maximum in August when summer thunderstorms occur.

Nearly half the annual precipitation falls as snow in the lower valley and the percentage increases as the elevation increases. The mean annual snowfall in the valley bottom averages about 70 inches per year, although as much as 175 inches has been reported in a single season. The heaviest recorded snowfall in a single month is 66 inches, which occurred in December 1916. At Snake Creek Power House, some 450 feet above the valley bottom, the average snowfall is 146 inches per year. The seasonal maximum at this site is 265 inches, which occurred in 1952.

Winds in the valley are generally light to moderate during all seasons of the year, but they become quite strong at higher elevations during winter storms. In the lower valley the strong winds that occur are generally associated with local thunderstorm activity.

Evaporation data from the Strawberry Reservoir, about 15 miles southeast of the Area at an elevation of about 8,000 feet, show seasonal evaporation to be about 38 inches, with 5 to 8 inches per month from May to September.

[5] This section was prepared by E. ARLO RICHARDSON, State climatologist, National Weather Service, U.S. Department of Commerce.

TABLE 12.—*Probabilities of last freezing temperatures in spring and first in fall*

[Data recorded at Heber, Utah]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	April 21	May 7	May 21	June 10	July 8.
2 years in 10 later than	April 15	May 1	May 14	June 4	July 1.
5 years in 10 later than	April 4	April 18	May 3	May 23	June 19.
Fall:					
1 year in 10 earlier than	October 16	October 2	September 16	August 31	August 19.
2 years in 10 earlier than	October 21	October 8	September 22	September 6	August 25.
5 years in 10 earlier than	October 31	October 20	October 2	September 17	September 4.

TABLE 13.—*Climatic data for Heber Valley Area*

Month	Temperature				Precipitation			
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average monthly total	One year in 10 will have		Average snowfall
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—	
	HEBER, UTAH							
	°F	°F	°F	°F	Inches	Inches	Inches	Inches
January	34.0	7.3	49.1	−19.3	1.79	0.63	3.37	19.7
February	38.5	11.9	50.4	−12.6	1.68	.51	3.48	14.4
March	47.7	21.1	62.1	+2.6	1.36	.69	3.11	9.1
April	60.0	28.5	73.0	17.3	1.15	.47	2.54	2.9
May	69.4	34.9	81.3	25.9	1.11	.27	2.03	0.8
June	79.4	39.9	87.3	32.3	.89	.04	1.81	[1] T
July	87.3	45.7	93.1	38.4	.75	.18	1.61	0
August	85.8	44.3	92.2	36.1	1.01	.11	2.34	[1] T
September	76.8	35.9	89.3	26.5	.75	.09	2.12	[1] T
October	65.1	27.9	79.7	18.0	1.25	.32	2.68	0.9
November	50.4	20.0	64.3	3.5	1.39	.22	2.57	6.2
December	36.6	11.4	52.0	−4.9	1.85	.41	3.43	15.9
Annual	60.9	27.4			14.98			69.9
	SNAKE CREEK POWER HOUSE, UTAH							
January	33.6	9.3	47.2	−11.6	3.16	0.68	4.69	35.8
February	37.9	12.4	51.3	−5.8	2.85	.86	4.53	30.4
March	45.3	19.3	59.5	2.2	2.49	1.22	4.47	21.8
April	57.2	27.8	71.2	16.7	1.72	.41	3.49	8.6
May	67.1	34.4	79.0	24.7	1.48	.21	2.71	1.6
June	76.4	40.2	87.5	28.6	1.06	.08	2.69	0.1
July	84.6	46.4	91.2	37.4	.80	.09	1.50	[1] T
August	82.3	45.3	90.5	35.5	1.11	.09	2.58	[1] T
September	74.3	37.8	85.6	27.7	.91	.16	1.69	0.3
October	63.5	29.6	75.8	19.3	1.55	.33	3.24	2.7
November	45.9	18.7	60.3	4.1	2.13	.56	3.54	13.9
December	37.4	13.7	50.8	2.7	3.03	.90	4.79	30.8
Annual	58.8	27.9			22.24			146.0

[1] Trace.

Physiography and Drainage

The Heber Valley Area consists of parts of two physiographic provinces. The major part (all but the mountainous area on the west side) is in the Colorado Plateaus province (*2*, *3*). The western part is in the Wasatch Mountains section of the Middle Rocky Mountain province.

The area is dissected by the Provo River, which flows through it from northeast to southwest. Tributaries to the Provo River have cut steep canyons in all directions. The floors of the two main valleys, Heber and Round Valley, range from nearly level, poorly drained areas to moderately sloping, well-drained stream terraces. The stream terraces appear to be the result of glacial outwash. The valley floors were probably old lake bottoms and flood plains. On the outer edges between the stream terraces and mountains are localized alluvial fans.

Part of the mountainous area has been glaciated. Many of the soils formed in glacial drift in old moraines. Others that formed in residuum, colluvium, and alluvium on the mountain slopes are generally steep or very steep.

A major fault extends through the area in the vicinity of Deer Creek Reservoir and south of Heber, as shown on the General Soil Map.

Water Supply

The principal source of water is the Provo River. Several smaller tributaries to this river are Center Creek, Daniels Creek, Lake Creek, Round Valley Creek, and Snake Creek. Some water is diverted from two adjacent systems—the Weber River to the north and the Duchesne River to the east—that enter the Provo River above Heber. One large storage reservoir, Deer Creek, is on this river downstream from Heber and Midway. The streams are used for domestic, livestock, and irrigation water. The reservoir water is used in adjacent counties to the west.

Settlement and Population

In the early days of the Utah Territory, the Heber Valley Area was included in Utah County. This condition prevailed until Wasatch County was created by the territorial legislature in 1862.

Prior to 1862, however, efforts had been made to colonize the Heber Valley. It was considered too high in elevation for the successful raising of crops, but it appeared to have excellent possibilities for the raising of livestock. As early as 1856 it was carefully explored for this purpose.

The first successful effort to colonize was in 1858, when a few men drove their livestock into Heber Valley, established ranches, and put up hay. In the winter of 1858–59, a number of men remained in the valley and fed stock, and in 1859, Heber City and Midway were established.

Wasatch County's population of about 5,800 is quite stable. It is made up of farmers and stockmen, miners, workers in clothing and other smaller industries, business people, Government workers, school teachers, and an increasing number of people who commute to Utah and Salt Lake Counties.

Heber City, population 3,000, is the county seat. Other towns are Midway, Charleston, Wallsburg, Center Creek, and Soldier Summit.

The predominant religious affiliation of all inhabitants in Wasatch County is with the Church of Jesus Christ of Latter Day Saints (Mormons). All communities have their own church buildings, which are modern and well kept.

Industry

The principal industries of this Area are farming—mainly livestock and dairy—lumbering, mining, clothing manufacturing, tourism, and recreation.

Mining has always been one of the primary segments of the local economy. Extensive deposits of nonferrous metals are in the northwest part of the Area in the Blue Ledge Mining District. Exploration in search of more mineral deposits is still carried on.

Lead and zinc mining, which reached a post-World War II high in employment of about 1,000 employees, has declined.

Farming and Livestock

About 20,116 acres in the Area are in crops. This includes 222 farms averaging about 90 acres in size. The main crops are alfalfa hay, improved pasture, meadow hay, wheat, barley, and oats.

Crop acreage and yields for a typical year are 7,635 acres of alfalfa, 22,905 tons; 1,124 acres of barley, 68,580 bushels; 187 acres of wheat, 7,637 bushels; 175 acres of oats, 9,839 bushels; 2,457 acres of meadow hay and other hay, 4,907 tons; 86 acres of grain harvested for hay, 204 tons; and 1,791 acres of improved pastures.

Major farm products exported from the Area annually are 2,500,000 gallons of milk, 9,921 cattle and calves, 80,000 lambs, 400,000 pounds of wool, 6,000 turkeys, 13,000 chickens and fryers, 182,000 dozen eggs, and 400 hogs.

Urbanization

The unprecedented movement of people from cities and towns into formerly rural areas has created many problems in sanitation, flood control, road and building construction, as well as farming. Summer home developments have already started in several parts of the Heber Valley Area. Many summer and year-round homes have been built in the mountains and foothills west and northwest of Midway. Expanding population into Wasatch County will require additional public services and such facilities as schools, churches, and recreational areas.

Land values in this area have taken a sharp rise in recent years. This is mainly due to the purchase of land for the Wasatch State Park, the summer homesite developments, and other speculative ventures. The result of this rise in land value has made it almost prohibitive to purchase land for farming.

Heber City, at the junction of U.S. Highways 40 and 189, has excellent commercial trucking service in all directions. Heber Valley is about 50 miles from modern air service at the Salt Lake airport. A small

airport for light aircraft located just 1 mile south of Heber is also the center for a glider school and soaring club.

Electric power for Heber Valley is supplied by the three communities of Heber City, Midway, and Charleston, who jointly own and operate hydro-electric plants on Snake Creek and the Provo River.

The Union Pacific Railroad serves the mines in the northern end of the county. The Heber Creeper is a recreational attraction between Heber and Vivian Park in Provo Canyon.

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Glossary

Alluvial fans. Alluvium deposited in fan- or cone-shaped deposits at the base of mountains.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Coarse fragments. The gravel, cobbles, or stones in a soil that range in size from 2 millimeters to 3 feet in diameter.

Cobbles. Rounded mineral or rock fragments that range from 3 to 10 inches in diameter.

Cobbly.—20 to 50 percent gravel and stones (dominantly cobbles).

Very cobbly.—More than 50 percent by volume cobbles, gravel, and stones (dominantly cobbles).

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Depth, soil. In this soil survey, the terms used to describe depth of the soil over bedrock or over a restricting layer are: *Deep*, more than 40 inches; *moderately deep*, 20 to 40 inches; *shallow*, 10 to 20 inches, and *very shallow*, less than 10 inches.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitation, or free, water has been allowed to drain away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity*, *normal moisture capacity*, or *capillary capacity*.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Gravelly soil. A soil in which 20 to 50 percent of material by volume consists of coarse fragments between 1/4 inch and 3 inches in diameter. A very gravelly soil is one in which 50 to 90 percent of material by volume is coarse fragments the size of gravel.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of

these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Irrigation water, released at high points, flows onto the field without controlled distribution.

Lime content. Refers to calcium carbonate or calcium magnesium carbonate. In this survey the terms used are: *Slightly calcareous*, 1 to 3 percent lime; *moderately calcareous*, 3 to 15 percent lime; *strongly calcareous*, 15 to 40 percent lime; and *very strongly calcareous*, more than 40 percent lime.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in dimeter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Nutrient, plant. The elements that may be taken in by a plant, essential to its growth, and used by it in the production of food and tissue. These include nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, and other elements obtained from the soil and oxygen, hydrogen and carbon obtained mainly from air and water.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Range. Land that primarily produces native forage plants that are suitable for grazing domestic livestock.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because is it neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Roots. Following are terms used to describe the number of roots that penetrate the soil: *Many,* more than 25 percent of surface area is penetrated; *common,* 3 to 25 percent of surface area is penetrated; *few,* less than 3 percent of surface area is penetrated.

Runoff. The rate that water flows from the land surface. Relative terms used to describe runoff are *very rapid, rapid, medium, slow, very slow;* and *ponded.*

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consists of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slope. Most mapping units have the percent slope as a part of the their name. Those that are not associations and lack percent slope are nearly level or gently sloping and have slopes of 3 percent or less. In this survey the soil names in an association have a slope adjective as follows:

	Range in percent
Moderately steep	5 to 15
Hilly	15 to 25
Steep	25 to 40
Very steep	40 to 60

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stones. Coarse fragments that range from 10 to 24 inches in diameter.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles) adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Topography. See Relief.

Water supplying capacity. The capacity of a soil to supply water that is stored during periods of plant dormancy plus the

precipitation during the growing season until moisture is depleted.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Moderately deep.—20 to 36 inches during part of the growing season.

Shallow.—0 to 20 inches during part of the growing season.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Predicted yields, table 2, page 55.

Engineering, tables 7 and 8, pages 78 to 101.

Map symbol	Mapping unit	Page	Capability unit: Irrigated	Page	Capability unit: Nonirrigated	Page	Range or woodland: Site	Page	Wildlife suitability group
AGF	Agassiz very cobbly loam, 25 to 60 percent slopes	9	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
AWF	Agassiz-Wallsburg association, very steep	9	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
BAC	Baird Hollow loam, 6 to 15 percent slopes	9	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	3141
BAD	Baird Hollow loam, 15 to 25 percent slopes	10	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	3141
BAE	Baird Hollow loam, 25 to 40 percent slopes	10	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	3141
BAF	Baird Hollow loam, 40 to 60 percent slopes	10	-------	----	VIIe-H	60	High Mountain Loam (Aspen)	63	3141
BCC	Baird Hollow-Flygare association, moderately steep	10	-------	----	-------	----	----------	----	3141
	Baird Hollow part	----	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	----
	Flygare part	----	-------	----	VIIs-H	60	High Mountain Stony Loam (Aspen)	64	----
BCE	Baird Hollow-Flygare association, steep	10	-------	----	-------	----	----------	----	3141
	Baird Hollow part	----	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	----
	Flygare part	----	-------	----	VIIs-H	60	High Mountain Stony Loam (Aspen)	64	----
BDC	Baird Hollow association, moderately steep	10	-------	----	-------	----	----------	----	3141
	Baird Hollow part	----	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	----
	Flygare part	----	-------	----	VIe-HC	59	Woodland	68	----
BeD2	Bezzant cobbly loam, 10 to 20 percent slopes, eroded	11	IVe-34	57	VIIs-U	60	Upland Stony Loam	67	2141-I 3242
BfC	Bezzant very cobbly loam, 6 to 10 percent slopes	11	-------	----	VIIs-U	60	Upland Stony Loam	67	3242
BGE	Bezzant very cobbly loam, 15 to 45 percent slopes	11	-------	----	VIIs-U	60	Upland Stony Loam	67	3242
BHF	Brad-Rock outcrop complex, 15 to 65 percent slopes	12	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4444
BKF	Bradshaw very cobbly very fine sandy loam, 40 to 60 percent slopes	12	-------	----	VIIs-M	60	Mountain Stony Loam	65	3242

Map symbol	Mapping unit	Page	Capability unit: Irrigated	Page	Capability unit: Nonirrigated	Page	Range or woodland: Site	Page	Wildlife suitability group
BLF	Bradshaw-Henefer association, very steep	12	-------	----	-------	----	----------	----	----
	Bradshaw part	----	-------	----	VIIs-M	60	Mountain Stony Loam	65	3242
	Henefer part	----	-------	----	VIIe-M	60	Mountain Loam	65	3141
BMF	Bradshaw-Wallsburg association, very steep	13	-------	----	VIIs-M	60	----------	----	----
	Bradshaw part	----	-------	----	-------	----	Mountain Stony Loam	65	3242
	Wallsburg part	----	-------	----	-------	----	Mountain Shallow Loam	66	4343
BOE	Broadhead very cobbly loam, 15 to 40 percent slopes	13	-------	----	VIIs-M	60	Mountain Loam	65	3141
BPC	Broadhead-Little Pole association, moderately steep	13	-------	----	-------	----	----------	----	----
	Broadhead part	----	-------	----	VIe-M	59	Mountain Loam	65	2141
	Little Pole part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
BPD	Broadhead-Little Pole association, hilly	14	-------	----	-------	----	----------	----	----
	Broadhead part	----	-------	----	VIe-M	59	Mountain Loam	65	2141
	Little Pole part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
BPE	Broadhead-Little Pole association, steep	14	-------	----	-------	----	----------	----	----
	Broadhead part	----	-------	----	VIe-M	59	Mountain Loam	65	2141
	Little Pole part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
BPF	Broadhead-Little Pole association, very steep	14	-------	----	-------	----	----------	----	----
	Broadhead loam and cobbly loam	----	-------	----	VIIe-M	60	Mountain Loam	65	3141
	Broadhead very cobbly loam	----	-------	----	VIIs-M	60	Mountain Loam	65	3141
	Little Pole part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
BTC	Broadhead soils, 6 to 15 percent slopes	14	-------	----	VIe-M	59	Mountain Loam	65	2141
	Broadhead loam	----	IIIe-3	56	-------	----	----------	----	----
	Broadhead cobbly loam	----	IVe-34	57	-------	----	----------	----	----
BTD	Broadhead soils, 15 to 25 percent slopes	15	-------	----	VIe-M	59	Mountain Loam	65	2141
BTE	Broadhead soils, 25 to 40 percent slopes	15	-------	----	VIe-M	59	Mountain Loam	65	2141
BTF	Broadhead soils, 40 to 60 percent slopes	15	-------	----	-------	----	Mountain Loam	65	3141
	Broadhead loam and cobbly loam	----	-------	----	VIIe-M	60	----------	----	----
	Broadhead very cobbly loam	----	-------	----	VIIs-M	60	----------	----	----
BVC	Buell gravelly loam, 6 to 15 percent slopes	16	-------	----	VIe-H	59	High Mountain Loam	63	3141
BVD	Buell gravelly loam, 15 to 25 percent slopes	16	-------	----	VIe-H	59	High Mountain Loam	63	3141
BVF	Buell gravelly loam, 25 to 60 percent slopes	16	-------	----	VIIe-H	60	High Mountain Loam	63	3141

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit: Irrigated	Page	Capability unit: Nonirrigated	Page	Range or woodland: Site	Page	Wildlife suitability group
BWE	Burgi gravelly loam, 25 to 40 percent slopes	16	-------	----	VIe-M	59	Mountain Gravelly Loam (Oakbrush)	65	2141
BWF	Burgi gravelly loam, 40 to 60 percent slopes	16	-------	----	VIIe-M	60	Mountain Gravelly Loam (Oakbrush)	65	3141
BXF	Burgi-Agassiz association, very steep	16	-------	----	-------	----	----------	----	----
	Burgi part	----	-------	----	VIIe-M	60	Mountain Gravelly Loam (Oakbrush)	65	3141
	Agassiz part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
BYF	Burgi-Wallsburg association, very steep	17	-------	----	-------	----	----------	----	----
	Burgi part	----	-------	----	VIIe-M	60	Mountain Gravelly Loam (Oakbrush)	65	3141
	Wallsburg part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
Ca	Center Creek loam	17	IIIw-3	56	-------	----	----------	----	2121-I
CBB	Clayburn loam, 3 to 6 percent slopes	18	-------	----	VIe-H	59	High Mountain Loam	63	3141
CBC	Clayburn loam, 6 to 15 percent slopes	18	-------	----	VIe-H	59	High Mountain Loam	63	3141
CBD	Clayburn loam, 15 to 25 percent slopes	18	-------	----	VIe-H	59	High Mountain Loam	63	3141
CCD	Clayburn-Flygare association, hilly	18	-------	----	VIe-H	59	----------	----	3141
	Clayburn part	----	-------	----	-------	----	High Mountain Loam	63	----
	Flygare part	----	-------	----	-------	----	High Mountain Loam (Aspen)	63	----
CDE	Clayburn soils, 25 to 40 percent slopes	18	-------	----	VIe-H	59	High Mountain Loam	63	3141
CgA	Clegg loam, 1 to 3 percent slopes	19	IIIc-3	56	-------	----	----------	----	2141-I
CgB	Clegg loam, 3 to 6 percent slopes	19	IIIe-3	56	-------	----	----------	----	2141-I
CgC	Clegg loam, 6 to 15 percent slopes	19	IIIe-3	56	VIe-U	59	Upland Loam	66	2141 2141-I
ChC	Clegg cobbly loam, 5 to 10 percent slopes	19	IVe-34	57	VIe-U	59	Upland Loam	66	2141 2141-I
CMD	Cloud Rim loam, 10 to 25 percent slopes	20	-------	----	VIe-M	59	Mountain Loam	65	2141
CME	Cloud Rim loam, 25 to 40 percent slopes	20	-------	----	VIe-M	59	Mountain Loam	65	2141
CNF	Cloud Rim soils, 40 to 60 percent slopes	20	-------	----	VIIe-M	60	Mountain Loam	65	3141
COF	Cluff-Daybell association, very steep	21	-------	----	-------	----	----------	----	3141
	Cluff part	----	-------	----	VIIe-HC	60	Woodland	68	----
	Daybell part	----	-------	----	VIIs-H	60	High Mountain Stony Loam (Aspen)	64	----

Map symbol	Mapping unit	Page	Capability unit: Irrigated	Page	Capability unit: Nonirrigated	Page	Range or woodland: Site	Page	Wildlife suitability group
CPC	Cluff soils, 6 to 15 percent slopes	21	-------	----	VIe-HC	59	Woodland	68	3141
CPD	Cluff soils, 15 to 25 percent slopes	21	-------	----	VIe-HC	59	Woodland	68	3141
CPF	Cluff soils, 40 to 60 percent slopes	21	-------	----	VIIe-HC	60	Woodland	68	3141
CrA	Crooked Creek clay loam, 1 to 3 percent slopes	22	IVw-35	57	-------	----	----------	----	2222-I
CrC	Crooked Creek clay loam, 3 to 10 percent slopes	22	IVw-35	57	-------	----	----------	----	2222-I
Cv	Cudahy silt loam, cold variant	23	Vw-43	59	-------	----	Semi-wet Meadows	66	2222-I
Cw	Cudahy silt loam, cold variant, moderately deep water table	23	IVe-33	57	-------	----	----------	----	3242-I
DAF	Daybell-Fitzgerald association, very steep	24	-------	----	-------	----	----------	----	3141
	Daybell part	----	-------	----	VIIs-H	60	High Mountain Stony Loam (Aspen)	64	----
	Fitzgerald part	----	-------	----	VIIe-HC	60	Woodland	68	----
DBE	Daybell soils, 25 to 40 percent slopes	24	-------	----	VIs-H	59	High Mountain Stony Loam (Aspen)	64	3141
DBF	Daybell soils, 40 to 65 percent slopes	25	-------	----	VIIs-H	60	High Mountain Stony Loam (Aspen)	64	3141
DcA	Deer Creek loam, 1 to 3 percent slopes	25	IIIc-3	56	-------	----	----------	----	2141-I
DcC	Deer Creek loam, 3 to 10 percent slopes	25	IIIe-3	56	-------	----	----------	----	2141-I
DWC	Deer Creek-Watkins Ridge complex, 6 to 15 percent slopes	26	-------	----	VIe-U	59	Upland Loam	66	2141
DWD	Deer Creek-Watkins Ridge complex, 15 to 25 percent slopes	26	-------	----	VIe-U	59	Upland Loam	66	2141
FA	Fluventic Haploborolls	27	VIw-4	59	-------	----	Wet Stream Bottoms	68	2131-I
FBB	Flygare loam, 3 to 6 percent slopes	28	-------	----	VIe-H	59	High Mountain Loam (Aspen)	64	3141
FBC	Flygare loam, 6 to 15 percent slopes	28	-------	----	VIe-H	59	High Mountain Loam (Aspen)	64	3141
FBD	Flygare loam, 15 to 25 percent slopes	28	-------	----	VIe-H	59	High Mountain Loam (Aspen)	64	3141
FLD	Flygare-Little Pole association, hilly	28	-------	----	-------	----	----------	----	----
	Flygare part	----	-------	----	VIe-H	59	High Mountain Loam (Aspen)	64	3141
	Little Pole part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
FLE	Flygare-Little Pole association, steep	28	-------	----	-------	----	----------	----	----
	Flygare part	----	-------	----	VIe-H	59	High Mountain Loam (Aspen)	64	3141
	Little Pole part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343

Map symbol	Mapping unit	Page	Capability unit: Irrigated	Page	Capability unit: Nonirrigated	Page	Range or woodland: Site	Page	Wildlife suitability group
FRE	Flygare soils, 25 to 40 percent slopes	29	-------	----	VIe-H	59	High Mountain Loam (Aspen)	64	3141
FRF	Flygare soils, 40 to 60 percent slopes	29	-------	----	VIIe-H	60	High Mountain Loam (Aspen)	64	3141
FSE	Flygare soils, sandy loam subsoil variant, 25 to 40 percent slopes	29	-------	----	VIe-HC	59	Woodland	68	3141
GAD	Gappmayer gravelly fine sandy loam, 15 to 25 percent slopes	30	IVe-34	57	VIe-M	59	Mountain Gravelly Loam (Oakbrush)	65	3242 3242-I
GAF	Gappmayer gravelly fine sandy loam, 40 to 65 percent slopes	30	-------	----	VIIe-M	60	Mountain Gravelly Loam (Oakbrush)	65	3242
GMF	Gappmayer very cobbly fine sandy loam, 40 to 65 percent slopes	30	-------	----	VIIs-M	60	Mountain Gravelly Loam (Oakbrush)	65	3242
GPF	Gappmayer-Bradshaw association, very steep	31	-------	----	VIIs-M	60	----------	----	3242
	Gappmayer part	----	-------	----	-------	----	Mountain Gravelly Loam (Oakbrush)	65	----
	Bradshaw part	----	-------	----	-------	----	Mountain Stony Loam	65	----
GWF	Gappmayer-Wallsburg association, very steep	31	-------	----	-------	----	----------	----	----
	Gappmayer part	----	-------	----	VIIe-M	60	Mountain Gravelly Loam (Oakbrush)	65	3242
	Wallsburg part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
HAC	Hailman loam, 6 to 15 percent slopes	31	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	3141
HAD	Hailman loam, 15 to 30 percent slopes	32	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	3141
HBF	Hailman soils, 40 to 60 percent slopes	32	-------	----	VIIe-H	60	High Mountain Loam (Aspen)	63	3141
HeA	Henefer silt loam, 1 to 3 percent slopes	32	IIIc-3	56	-------	----	----------	----	2141-I
HeC	Henefer silt loam, 6 to 10 percent slopes	32	IIIe-3	56	VIe-M	59	Mountain Loam	65	2141 2141-I
HeD	Henefer silt loam, 10 to 25 percent slopes	32	IVe-3	57	VIe-M	59	Mountain Loam	65	2141 2141-I
HFF	Henefer-Bradshaw association, very steep	33	-------	----	-------	----	----------	----	----
	Henefer part	----	-------	----	VIIe-M	60	Mountain Loam	65	3141
	Bradshaw part	----	-------	----	VIIs-M	60	Mountain Stony Loam	65	3242
HGF	Henefer-Gappmayer association, very steep	33	-------	----	VIIe-M	60	----------	----	----
	Henefer part	----	-------	----	-------	----	Mountain Loam	65	3141
	Gappmayer part	----	-------	----	-------	----	Mountain Gravelly Loam (Oakbrush)	65	3242

Map symbol	Mapping unit	Page	Capability unit: Irrigated	Page	Capability unit: Nonirrigated	Page	Range or woodland: Site	Page	Wildlife suitability group
HHF	Henefer-Wallsburg association, very steep	33	-------	----	-------	----	----------	----	----
	Henefer part	----	-------	----	VIIe-M	60	Mountain Loam	65	3141
	Wallsburg part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
HJC	Henefer soils, 6 to 10 percent slopes	33	-------	----	VIe-M	59	Mountain Loam	65	2141
HJD	Henefer soils, 10 to 25 percent slopes	33	-------	----	VIe-M	59	Mountain Loam	65	2141
HJE	Henefer soils, 25 to 50 percent slopes	33	-------	----	VIIe-M	60	Mountain Loam	65	3141
Hk	Holmes cobbly sandy loam	34	IVs-34	58	-------	----	----------	----	3242-I
Hm	Holmes cobbly sandy loam, channeled	34	IVs-34	58	-------	----	----------	----	3242-I
Ho	Holmes very cobbly sandy loam	34	-------	----	VIIs-U	60	Upland Stony Loam	67	3242
Hr	Holmes gravelly loam	34	IVs-34	58	-------	----	----------	----	3242-I
HWC	Horrocks-Broadhead association, moderately steep	35	-------	----	-------	----	----------	----	2141
	Horrocks part	----	-------	----	VIIs-M	60	Mountain Stony Loam	65	----
	Broadhead part	----	-------	----	VIe-M	59	Mountain Loam	65	----
HWE	Horrocks-Broadhead association, steep	35	-------	----	-------	----	----------	----	2141
	Horrocks part	----	-------	----	VIIs-M	60	Mountain Stony Loam	65	----
	Broadhead part	----	-------	----	VIe-M	59	Mountain Loam	65	----
HWF	Horrocks-Broadhead association, very steep	35	-------	----	-------	----	----------	----	3141
	Horrocks part	----	-------	----	VIIs-M	60	Mountain Stony Loam	65	----
	Broadhead part	----	-------	----	VIIe-M	60	Mountain Loam	65	----
Kc	Kovich loam	36	IIIw-3	56	-------	----	----------	----	2222-I
Kd	Kovich loam, channeled	36	IIIw-3	56	-------	----	----------	----	2222-I
Kh	Kovich loam, moderately deep water table	36	IIIw-3	56	-------	----	----------	----	2121-I
Km	Kovich loam, deep water table variant	37	IIIw-3	56	-------	----	----------	----	2121-I
Kp	Kovich loam, gravelly subsoil variant	37	IVw-34	57	-------	----	----------	----	2222-I
Kr	Kovich loam, gravelly subsoil variant, channeled	37	IVw-34	57	-------	----	----------	----	2222-I
Ks	Kovich loam, gravelly subsoil variant, moderately deep water table	37	IVw-34	57	-------	----	----------	----	2222-I
LAE	Lake Janee soils, 15 to 40 percent slopes	38	-------	----	VIe-HC	59	Woodland	68	3141
LPD	Little Pole very cobbly sandy clay loam, 6 to 25 percent slopes	39	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
LPF	Little Pole very cobbly sandy clay loam, 40 to 60 percent slopes	39	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
Lr	Logan silty clay, cold variant	40	IIIw-3	56	-------	----	----------	----	2222-I
MaB	Manila silt loam, 3 to 6 percent slopes	40	IIIe-3	56	-------	----	----------	----	2141-I

Map symbol	Mapping unit	Page	Capability unit: Irrigated	Page	Capability unit: Nonirrigated	Page	Range or woodland: Site	Page	Wildlife suitability group
MaC	Manila silt loam, 6 to 10 percent slopes	40	IIIe-3	56	-------	----	----------	----	2141-I
MaD	Manila silt loam, 10 to 20 percent slopes	40	IVe-3	57	VIe-M	59	Mountain Loam	65	2141 2141-I
MCF	McPhie fine sandy loam, 40 to 60 percent slopes	41	-------	----	VIIe-M	60	Mountain Gravelly Loam (Oakbrush)	65	3141
MHF	McPhie-Henefer association, very steep	41	-------	----	VIIe-M	60	----------	----	3141
	McPhie part	----	-------	----	-------	----	Mountain Gravelly Loam (Oakbrush)	65	----
	Henefer part	----	-------	----	-------	----	Mountain Loam	65	----
MRE	Mult clay loam, thick solum variant, 25 to 40 percent slopes	42	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	3141
MSD	Mult soils, thick solum variant, 5 to 25 percent slopes	42 42	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	3141
POF	Poleline soils, 40 to 70 percent slopes	43	-------	----	VIIs-H	60	High Mountain Stony Loam (Aspen)	64	3141
RaB	Rasband coarse sandy loam, 3 to 6 percent slopes	43	IIIe-3	56	VIe-M	59	Mountain Loam	65	2141 2141-I
RCC	Rasband coarse sandy loam, 6 to 15 percent slopes	43	IIIe-3	56	VIe-M	59	Mountain Loam	65	2141 2141-I
RdA	Rasband loam, 1 to 3 percent slopes	43	IIIc-3	56	-------	----	----------	----	2141-I
RdC	Rasband loam, 3 to 10 percent slopes	44	IIIe-3	56	-------	----	----------	----	2141-I
RO	Rock land	44	-------	----	VIIIs-X	61	----------	----	4444
Rp	Rock land, travertine	44	-------	----	VIIIs-X	61	----------	----	4444
RRC	Roundy loam, 5 to 15 percent slopes	45	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	3141
RRD	Roundy loam, 15 to 25 percent slopes	45	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	3141
RRE	Roundy loam, 25 to 40 percent slopes	45	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	3141
RRF	Roundy loam, 40 to 60 percent slopes	45	-------	----	VIIe-H	60	High Mountain Loam (Aspen)	63	3141
RSC	Roundy-Cluff association, moderately steep	45	-------	----	-------	----	----------	----	3141
	Roundy part	----	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	----
	Cluff part	----	-------	----	VIe-HC	59	Woodland	68	----
RSD	Roundy-Cluff association, hilly-	45	-------	----	-------	----	----------	----	3141
	Roundy part	----	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	----
	Cluff part	----	-------	----	VIe-HC	59	Woodland	68	----

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit: Irrigated	Page	Capability unit: Nonirrigated	Page	Range or woodland: Site	Page	Wildlife suitability group
RUF	Roundy-Daybell association, very steep	46	-------	----	-------	----	High Mountain Loam (Aspen)	63	3141
	Roundy part	----	-------	----	VIIe-H	60	----------	----	----
	Daybell part	----	-------	----	VIIs-H	60	----------	----	----
RYD	Roundy soils, 15 to 25 percent slopes	46	-------	----	VIe-H	59	High Mountain Loam (Aspen)	63	3141
SEC	Sessions clay loam, 5 to 15 percent slopes	46	-------	----	VIe-H	59	High Mountain Loam	63	3141
SED	Sessions clay loam, 15 to 25 percent slopes	46	-------	----	VIe-H	59	High Mountain Loam	63	3141
SpB	Spaa silt loam, 2 to 5 percent slopes	47	IVe-33	57	-------	----	----------	----	3242-I
St	Steed loam, cold variant	47	IVs-34	58	-------	----	----------	----	3242-I
Sv	Steed cobbly loam, cold variant	48	IVs-34	58	-------	----	----------	----	3242-I
VMF	Van Wagoner-McPhie association, very steep	48	-------	----	-------	----	----------	----	----
	Van Wagoner part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
	McPhie part	----	-------	----	VIIe-M	60	Mountain Gravelly Loam (Oakbrush)	65	3141
VWF	Van Wagoner-Rock outcrop complex, 40 to 70 percent slopes	48	-------	----	-------	----	----------	----	----
	Van Wagoner part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
	Rock outcrop part	----	-------	----	VIIIs-X	61	----------	----	4444
WBF	Wallsburg-Rock outcrop complex, 20 to 60 percent slopes	49	-------	----	-------	----	----------	----	----
	Wallsburg part	----	-------	----	VIIs-M	60	Mountain Shallow Loam	66	4343
	Rock outcrop part	----	-------	----	VIIIs-X	61	----------	----	4444
WcC	Watkins Ridge silt loam, 6 to 15 percent slopes	50	IIIe-3	56	VIe-U	59	Upland Loam	66	2141 2141-I
WcD	Watkins Ridge silt loam, 15 to 25 percent slopes	50	-------	----	VIe-U	59	Upland Loam	66	2141
WLC	Watkins Ridge-Clegg complex, 6 to 15 percent slopes	50	-------	----	VIe-U	59	Upland Loam	66	2141
WLD	Watkins Ridge-Clegg complex, 15 to 25 percent slopes	50	-------	----	VIe-U	59	Upland Loam	66	2141
WNC	Watkins Ridge-Deer Creek complex, 6 to 15 percent slopes	50	-------	----	VIe-U	59	Upland Loam	66	2141
WND	Watkins Ridge-Deer Creek complex, 15 to 25 percent slopes	50	-------	----	VIe-U	59	Upland Loam	66	2141
WPF	Whipstock very cobbly loam, 15 to 60 percent slopes	51	-------	----	VIIs-M	60	Mountain Stony Loam	65	3141
WSC	Whipstock soils, 6 to 15 percent slopes	51	-------	----	VIe-M	59	Mountain Loam	65	2141
WSD	Whipstock soils, 15 to 25 percent slopes	51	-------	----	VIe-M	59	Mountain Loam	65	2141
WSE	Whipstock soils, 25 to 40 percent slopes	51	-------	----	VIe-M	59	Mountain Loam	65	2141

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YaB	Yeates Hollow loam, 2 to 5 percent slopes	52	IIIe-3	56	-------	----	----------	----	2141-I
YEC	Yeates Hollow very cobbly loam, 6 to 15 percent slopes	52	-------	----	VIIs-M	60	Mountain Stony Loam	65	2141
YED	Yeates Hollow very cobbly loam, 15 to 25 percent slopes	52	-------	----	VIIs-M	60	Mountain Stony Loam	65	2141
YTC	Yeates Hollow-Henefer association, moderately steep	52	-------	----	-------	----	----------	----	2141
	Yeates Hollow part	----	-------	----	VIIs-M	60	Mountain Stony Loam	65	----
	Henefer part	----	-------	----	VIe-M	59	Mountain Loam	65	----
YTD	Yeates Hollow-Henefer association, hilly	52	-------	----	-------	----	----------	----	2141
	Yeates Hollow part	----	-------	----	VIIs-M	60	Mountain Stony Loam	65	----
	Henefer part	----	-------	----	VIe-M	59	Mountain Loam	65	----

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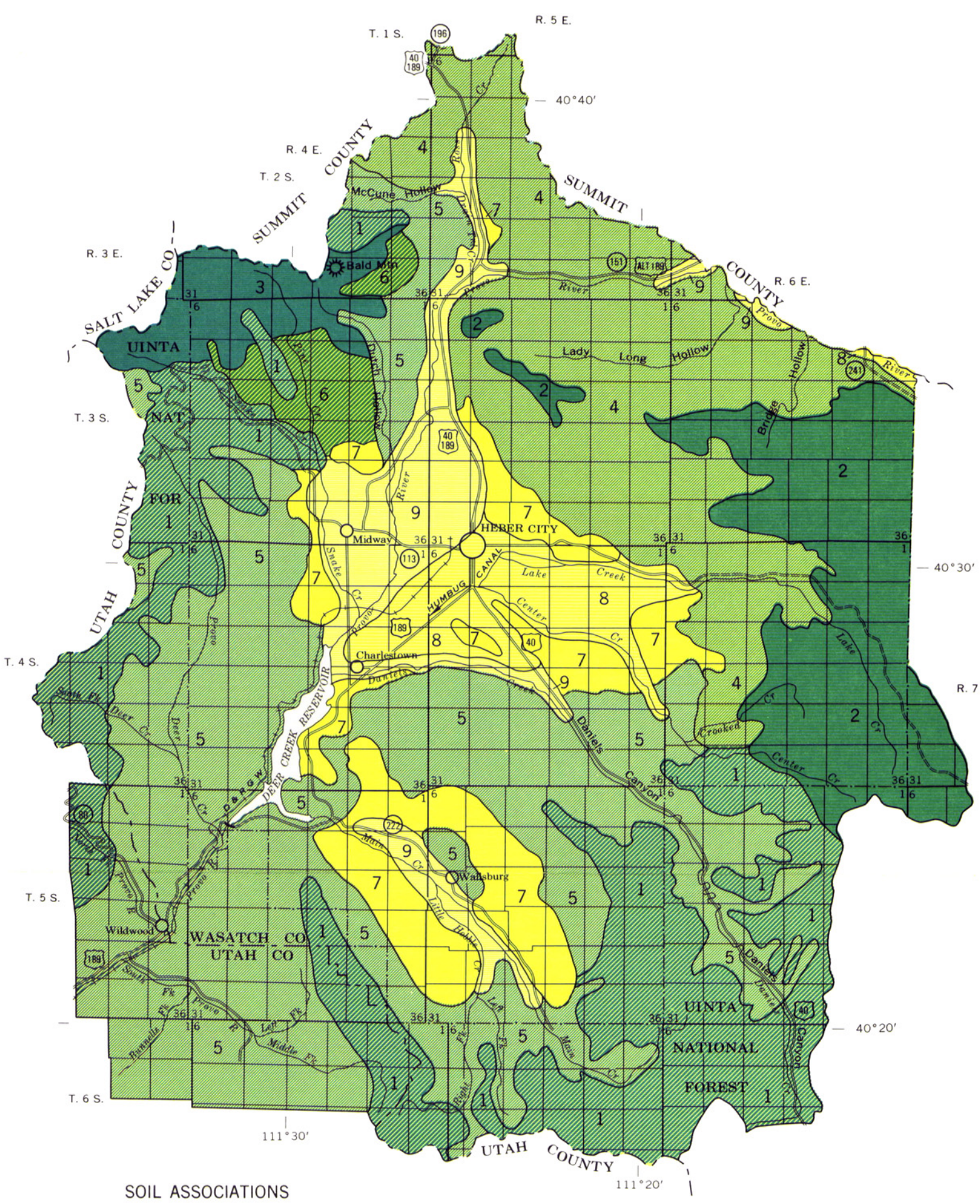


SOIL ASSOCIATIONS

1. Roundy-Daybell association: Well drained and somewhat excessively drained, deep soils formed in residuum and colluvium from mixed sedimentary rocks on high mountainsides and plateaus
2. Flygare-Clayburn-Baird Hollow association: Well-drained, deep soils formed in glacial drift from andesite on high mountainsides and plateaus
3. Hailman-Buell-Lake Janee association: Well-drained, deep soils formed in glacial drift from quartz-diorite porphyry or in colluvium and alluvium from quartzite on high mountainsides
4. Broadhead-Little Pole association: Well-drained, deep and shallow soils formed in alluvium, colluvium, or residuum from andesite on mountainsides and alluvial fans
5. Gappmayer-Henefer-Wallsburg association: Well-drained, deep and shallow soils formed in alluvium, colluvium, and residuum from mixed sedimentary rocks on mountainsides and alluvial fans
6. Van Wagoner-Cloud Rim-McPhie association: Well-drained, shallow and deep soils formed in residuum and glacial drift from quartz-diorite porphyry and in alluvium and colluvium from mixed sedimentary rocks on mountainsides, alluvial fans, colluvial cones, and terminal moraines
7. Yeates Hollow-Watkins Ridge-Deer Creek association: Well-drained, deep soils formed in alluvium and residuum from mixed sedimentary rocks on foothills, mountain foot slopes, and alluvial fans
8. Holmes-Rasband association: Well drained and somewhat poorly drained, deep soils formed in mixed alluvium on alluvial fans and stream terraces
9. Kovich-Fluventic Haploborolls-Crooked Creek association: Moderately well drained and poorly drained, deep soils formed in mixed alluvium on flood plains, low stream terraces, and valley bottoms

Compiled 1973

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FOREST SERVICE

UTAH AGRICULTURAL EXPERIMENT STATION

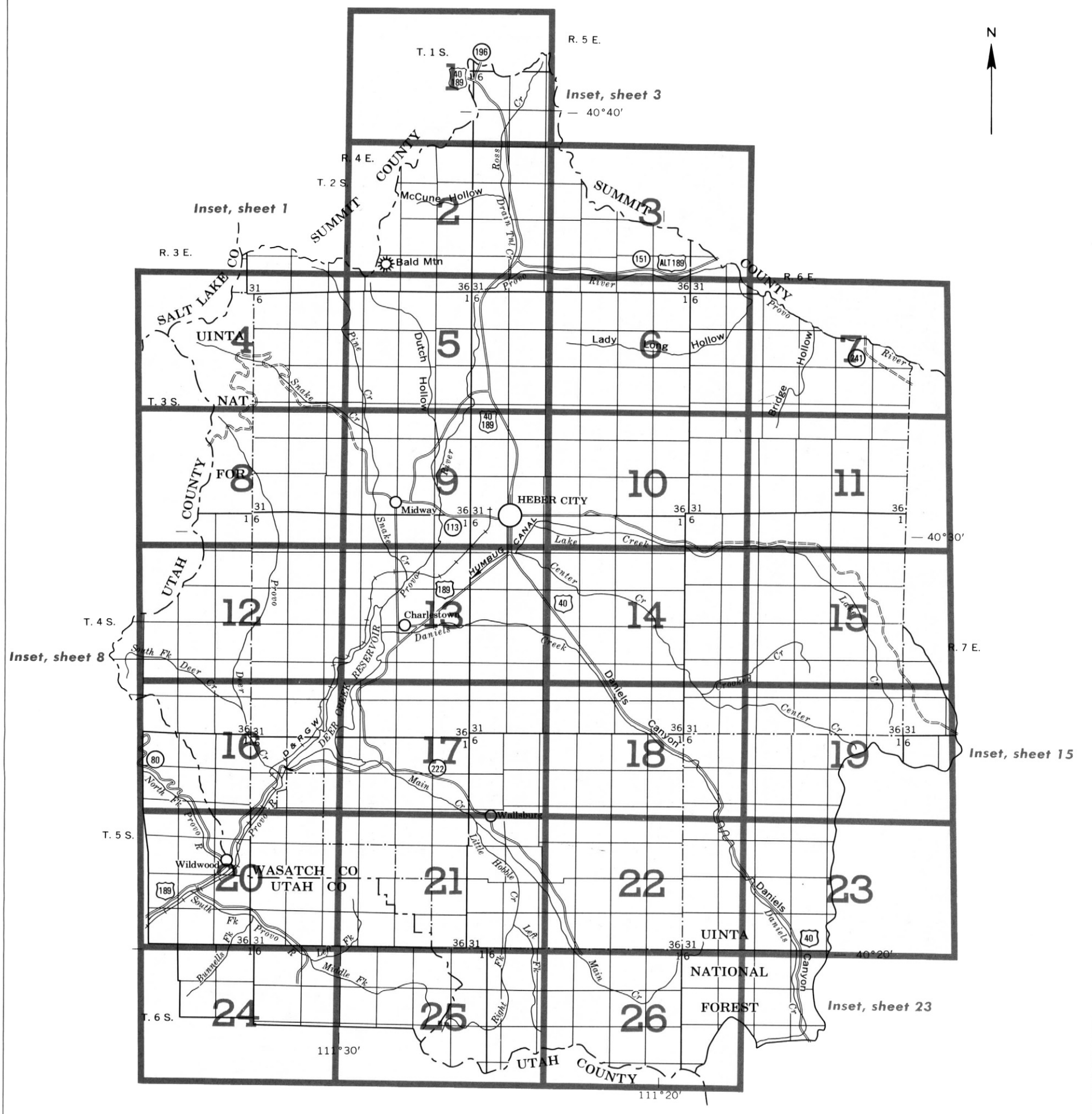
GENERAL SOIL MAP

HEBER VALLEY AREA, UTAH

PARTS OF WASATCH AND UTAH COUNTIES

Scale 1:190,080

1 0 1 2 3 4 Miles



SECTIONALIZED TOWNSHIP					
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

HEBER VALLEY AREA, UTAH

PARTS OF WASATCH AND UTAH COUNTIES

Scale 1:190,080

1 0 1 2 3 4 Miles

SOIL LEGEND

The first letter, always a capital, is the initial letter of the soil name. The second letter is a capital if the mapping unit is one of low intensity; otherwise it is a small letter. The third letter, always a capital, A, B, C, D, E, or F shows the slope. Most symbols without slope letters are those of nearly level soils, but some are for miscellaneous land types or undifferentiated groups that have a considerable range of slope.

SYMBOL		NAME
High Intensity	Low Intensity *	
-	AGF	Agassiz very cobbly loam, 25 to 60 percent slopes
-	AWF	Agassiz-Wallsburg association, very steep
-	BAC	Baird Hollow loam, 6 to 15 percent slopes
-	BAD	Baird Hollow loam, 15 to 25 percent slopes
-	BAE	Baird Hollow loam, 25 to 40 percent slopes
-	BAF	Baird Hollow loam, 40 to 60 percent slopes
-	BCC	Baird Hollow-Flygare association, moderately steep
-	BCE	Baird Hollow-Flygare association, steep
-	BDC	Baird Hollow association, moderately steep
BeD2	-	Bezzant cobbly loam, 10 to 20 percent slopes, eroded
BfC	-	Bezzant very cobbly loam, 6 to 10 percent slopes
-	BGE	Bezzant very cobbly loam, 15 to 45 percent slopes
-	BHF	Brad-Rock outcrop complex, 15 to 65 percent slopes
-	BKF	Bradshaw very cobbly very fine sandy loam, 40 to 60 percent slopes
-	BLF	Bradshaw-Henefer association, very steep
-	BMF	Bradshaw-Wallsburg association, very steep
-	BOE	Broadhead very cobbly loam, 15 to 40 percent slopes
-	BPC	Broadhead-Little Pole association, moderately steep
-	BPD	Broadhead-Little Pole association, hilly
-	BPE	Broadhead-Little Pole association, steep
-	BPF	Broadhead-Little Pole association, very steep
-	BTC	Broadhead soils, 6 to 15 percent slopes
-	BTD	Broadhead soils, 15 to 25 percent slopes
-	BTE	Broadhead soils, 25 to 40 percent slopes
-	BTF	Broadhead soils, 40 to 60 percent slopes
-	BVC	Buell gravelly loam, 6 to 15 percent slopes
-	BVD	Buell gravelly loam, 15 to 25 percent slopes
-	BVF	Buell gravelly loam, 25 to 60 percent slopes
-	BWE	Burgi gravelly loam, 25 to 40 percent slopes
-	BWF	Burgi gravelly loam, 40 to 60 percent slopes
-	BXF	Burgi-Agassiz association, very steep
-	BYF	Burgi-Wallsburg association, very steep
Ca	-	Center Creek loam
-	CBB	Clayburn loam, 3 to 6 percent slopes
-	CBC	Clayburn loam, 6 to 15 percent slopes
-	CBD	Clayburn loam, 15 to 25 percent slopes
-	CCD	Clayburn-Flygare association, hilly
-	CDE	Clayburn soils, 25 to 40 percent slopes
CgA	-	Clegg loam, 1 to 3 percent slopes
CgB	-	Clegg loam, 3 to 6 percent slopes
CgC	-	Clegg loam, 6 to 15 percent slopes
ChC	-	Clegg cobbly loam, 5 to 10 percent slopes
-	CMD	Cloud Rim loam, 10 to 25 percent slopes
-	CME	Cloud Rim loam, 25 to 40 percent slopes
-	CNF	Cloud Rim soils, 40 to 60 percent slopes
-	COF	Cluff-Daybell association, very steep
-	CPC	Cluff soils, 6 to 15 percent slopes
-	CPD	Cluff soils, 15 to 25 percent slopes
-	CPF	Cluff soils, 40 to 60 percent slopes
CrA	-	Crooked Creek clay loam, 1 to 3 percent slopes
CrC	-	Crooked Creek clay loam, 3 to 10 percent slopes
Cv	-	Cudahy silt loam, cold variant
Cw	-	Cudahy silt loam, cold variant, moderately deep water table
-	DAF	Daybell-Fitzgerald association, very steep
-	DBE	Daybell soils, 25 to 40 percent slopes
-	DBF	Daybell soils, 40 to 65 percent slopes
DcA	-	Deer Creek loam, 1 to 3 percent slopes
DcC	-	Deer Creek loam, 3 to 10 percent slopes
-	DWC	Deer Creek-Watkins Ridge complex, 6 to 15 percent slopes
-	DWD	Deer Creek-Watkins Ridge complex, 15 to 25 percent slopes
-	FA	Fluventic Haploborolls
-	FBB	Flygare loam, 3 to 6 percent slopes
-	FBC	Flygare loam, 6 to 15 percent slopes
-	FBD	Flygare loam, 15 to 25 percent slopes
-	FLD	Flygare-Little Pole association, hilly
-	FLE	Flygare-Little Pole association, steep
-	FRE	Flygare soils, 25 to 40 percent slopes
-	FRF	Flygare soils, 40 to 60 percent slopes
-	FSE	Flygare soils, sandy loam subsoil variant, 25 to 40 percent slopes
-	GAD	Gappmayer gravelly fine sandy loam, 15 to 25 percent slopes
-	GAF	Gappmayer gravelly fine sandy loam, 40 to 65 percent slopes
-	GMF	Gappmayer very cobbly fine sandy loam, 40 to 65 percent slopes
-	GPF	Gappmayer-Bradshaw association, very steep
-	GWF	Gappmayer-Wallsburg association, very steep
-	HAC	Hailman loam, 6 to 15 percent slopes
-	HAD	Hailman loam, 15 to 30 percent slopes
-	HBF	Hailman soils, 40 to 60 percent slopes
HeA	-	Henefer silt loam, 1 to 3 percent slopes
HeC	-	Henefer silt loam, 6 to 10 percent slopes
HeD	-	Henefer silt loam, 10 to 25 percent slopes
-	HFF	Henefer-Bradshaw association, very steep
-	HGF	Henefer-Gappmayer association, very steep
-	HHF	Henefer-Wallsburg association, very steep
-	HJC	Henefer soils, 6 to 10 percent slopes
-	HJD	Henefer soils, 10 to 25 percent slopes
-	HJE	Henefer soils, 25 to 50 percent slopes
Hk	-	Holmes cobbly sandy loam
Hm	-	Holmes cobbly sandy loam, channeled
Ho	-	Holmes very cobbly sandy loam
Hr	-	Holmes gravelly loam
-	HWC	Horrocks-Broadhead association, moderately steep
-	HWE	Horrocks-Broadhead association, steep
-	HWF	Horrocks-Broadhead association, very steep
Kc	-	Kovich loam
Kd	-	Kovich loam, channeled
Kh	-	Kovich loam, moderately deep water table
Km	-	Kovich loam, deep water table variant
Kp	-	Kovich loam, gravelly subsoil variant
Kr	-	Kovich loam, gravelly subsoil variant, channeled
Ks	-	Kovich loam, gravelly subsoil variant, moderately deep water table
-	LAE	Lake Janee soils, 15 to 40 percent slopes
-	LPD	Little Pole very cobbly sandy clay loam, 6 to 25 percent slopes
-	LPF	Little Pole very cobbly sandy clay loam, 40 to 60 percent slopes
Lr	-	Logan silty clay, cold variant
MaB	-	Manila silt loam, 3 to 6 percent slopes
MaC	-	Manila silt loam, 6 to 10 percent slopes
MaD	-	Manila silt loam, 10 to 20 percent slopes
-	MCF	McPhie fine sandy loam, 40 to 60 percent slopes
-	MHF	McPhie-Henefer association, very steep
-	MRE	Mult clay loam, thick solum variant, 25 to 40 percent slopes
-	MSD	Mult soils, thick solum variant, 5 to 25 percent slopes
-	POF	Poleline soils, 40 to 70 percent slopes
RaB	-	Rasband coarse sandy loam, 3 to 6 percent slopes
-	RCC	Rasband coarse sandy loam, 6 to 15 percent slopes
RdA	-	Rasband loam, 1 to 3 percent slopes
RdC	-	Rasband loam, 3 to 10 percent slopes
-	RO	Rock land
Rp	-	Rock land, travertine
-	RRC	Roundy loam, 5 to 15 percent slopes
-	RRD	Roundy loam, 15 to 25 percent slopes
-	RRE	Roundy loam, 25 to 40 percent slopes
-	RRF	Roundy loam, 40 to 60 percent slopes
-	RSC	Roundy-Cluff association, moderately steep
-	RSD	Roundy-Cluff association, hilly
-	RUF	Roundy-Daybell association, very steep
-	RYD	Roundy soils, 15 to 25 percent slopes
-	SEC	Sessions clay loam, 5 to 15 percent slopes
-	SED	Sessions clay loam, 15 to 25 percent slopes
SpB	-	Spaa silt loam, 2 to 5 percent slopes
St	-	Steed loam, cold variant
Sv	-	Steed cobbly loam, cold variant
-	VMF	Van Wagoner-McPhie association, very steep
-	VWF	Van Wagoner-Rock outcrop complex, 40 to 70 percent slopes
-	WBF	Wallsburg-Rock outcrop complex, 20 to 60 percent slopes
WcC	-	Watkins Ridge silt loam, 6 to 15 percent slopes
WcD	-	Watkins Ridge silt loam, 15 to 25 percent slopes
-	WLC	Watkins Ridge-Clegg complex, 6 to 15 percent slopes
-	WLD	Watkins-Ridge-Clegg complex, 15 to 25 percent slopes
-	WNC	Watkins-Ridge-Deer Creek complex, 6 to 15 percent slopes
-	WND	Watkins Ridge-Deer Creek complex, 15 to 25 percent slopes
-	WPF	Whipstock very cobbly loam, 15 to 60 percent slopes
-	WSC	Whipstock soils, 6 to 15 percent slopes
-	WSD	Whipstock soils, 15 to 25 percent slopes
-	WSE	Whipstock soils, 25 to 40 percent slopes
YaB	-	Yeates Hollow loam, 2 to 5 percent slopes
-	YEC	Yeates Hollow very cobbly loam, 6 to 15 percent slopes
-	YED	Yeates Hollow very cobbly loam, 15 to 25 percent slopes
-	YTC	Yeates Hollow-Henefer association, moderately steep
-	YTD	Yeates Hollow-Henefer association, hilly

* The composition of these units is more variable than that of the others in the survey area but has been controlled well enough to be interpreted for the expected use of the soil.

HEBER VALLEY AREA, UTAH, PARTS OF WASATCH AND UTAH COUNTIES

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads

- Divided
- Good motor
- Poor motor
- Trail

Highway markers

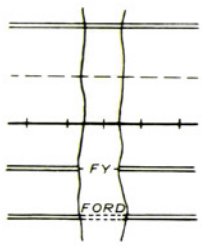
- National Interstate
- U. S.
- State or county

Railroads

- Single track
- Multiple track
- Abandoned

Bridges and crossings

- Road
- Trail
- Railroad
- Ferry
- Ford
- Grade
- R. R. over
- R. R. under



- Buildings
- School
- Church
- Mine and quarry
- Gravel pit
- Power line
- Pipeline
- Cemetery
- Dams
- Levee
- Tanks
- Well, oil or gas
- Forest fire or lookout station
- Windmill
- Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Soil survey
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line

- Perennial
- Intermittent

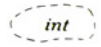
Streams, single-line

- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified
- Canals and ditches

Lakes and ponds

- Perennial

- Intermittent



- Spring
- Aqueduct, single line
- Wet spot
- Drainage end or alluvial fan

RELIEF

Escarpments

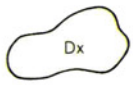
- Bedrock
- Other
- Short steep slope
- Prominent peak

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

- Soil boundary and symbol



- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

HEBER VALLEY AREA, UTAH — SHEET NUMBER 1

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the Utah Agricultural Experiment Station.
Photobase from 1953, 1962 and 1969 aerial photography. Positions of 10,000-foot grid ticks are approximate and based on the coordinate system, Utah central zone.
Land division corners are approximately positioned on this map.

HEBER VALLEY AREA, UTAH NO. 1

2 010 000 FEET
1 990 000 FEET
2 000 000 FEET
830 000 FEET
828 000 FEET
860 000 FEET
850 000 FEET
2 030 000 FEET
2000 AND 10000-FOOT TICKS

R. 3 E. | R. 4 E.
R. 4 E. | R. 5 E.
T. 2 S. | T. 1 S.

(Joins sheet 4)
(Joins sheet 2)
(Joins inset, sheet 3)

SALT LAKE COUNTY
SUMMIT COUNTY
UNION PACIFIC

Bloods Lake
Pine Creek
Hollow
Todd Creek
Ross Creek

RO
BVF
BVD
BVC
HAD
HAC
LAE
LPF
HBF
BTD
BTC
HWE
HWC
BPF
BPD
RaB

Scale 1:24000

2 Miles
10000 Feet
5000
5 000
4000
3000
2000
1000
0
1
¼
½
¾
1

HEBER VALLEY AREA, UTAH — SHEET NUMBER 2

Land division corners are approximately positioned on this map.

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HEBER VALLEY AREA, UTAH NO. 3

(Joins inset)

2 040 000 FEET

840 000 FEET

T. 2 S.

(Joins sheet 2)

9 16 15 21 22 28 27 26 25 30 33 34 35 36 31 32

Dead Man Gulch

Bone Hollow

Hollow

Murdock

BPF BPE BPD BPC LPD LPF RCC RaB Ke HWE RdC FA

SUMMIT COUNTY

THE WEST HILLS

ALT 189

151

Provo River

PROVO RIVER CANAL

2 050 000 FEET

R. 5 E. | R. 6 E.

(Joins sheet 6)

2 030 000 FEET

855 000 FEET

(Joins sheet 1)

T. 2 S.

4 9

SUMMIT COUNTY

850 000 FEET

2 032 000 FEET

R. 5 E.

(Joins top left)

2000 AND 5000-FOOT-GRID TICKS

830 000 FEET

3

N

2 Miles

10000 Feet

1 5000 0 0

¼ 1 000

½ 2000

¾ 3000

1 4000

1 5000

Scale 1:24 000

(Joins inset, sheet 1)

R. 3 E. | R. 4 E.

2 000 000 FEET

T. 3 S. | T. 2 S.

820 000 FEET

(Joins sheet 5)

N

2 Miles

10000 Feet

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

1/4 1/2 3/4 1

810 000 FEET

(Joins sheet 8)

1 980 000 FEET

36 31 32 33 5 4 6 7 8 9 18 17 16 19 20 21

RO LAE HAD HAC BVD BVC HBF VWF BVF HBF BKF RRF MCF RRE RRD AGF CNF DBF RUF HeD

Lake Brimhall

Silver Lake

Silver Lake Inlet

Lackawaxen Lake

WASATCH MTN STATE PARK

WMSP

Boulder Basin

Pine Creek

Midway Reservoir

Lauina Peak

Springer Hollow

SALT LAKE COUNTY

UTAH COUNTY

U I N T A

NATIONAL FOREST

Snake Creek

Big Flat Spring

B I G F L A T

Mill Flat

Ant Knoll

W A S A T C H M O U N T A I N

S T A T E P A R K

Epperson Spring

Land division corners are approximately positioned on this map

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HEBER VALLEY AREA, UTAH — SHEET NUMBER 5

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Land division corners are approximately positioned on this map.

HEBER VALLEY AREA, UTAH NO. 5

2 010 000 FEET

R. 4 E. | R. 5 E.

(Joins sheet 2)

T. 3 S. | T. 2 S.

820 000 FEET

(Joins sheet 4)

(Joins sheet 9)

(Joins sheet 6)

2 030 000 FEET

810 000 FEET

W A S A T C H M O U N T A I N S T A T E P A R K

Jordanelle

Provo River

Provo River Aqueduct

Timpanogos Canal

Gravel Pit

Cottonwood Canyon

Dutch Hollow

Pine Creek

Springer Hollow

Rock Creek

Coyote Canyon

Wasatch

GP

5

N

2 Miles

10000 Feet

Scale 1:24000

(Joins sheet 3)

R. 5 E. | R. 6 E.

2 050 000 FEET

T. 3 S. | T. 2 S.

820 000 FEET

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

5000

810 000 FEET

2 030 000 FEET

(Joins sheet 5)

(Joins sheet 7)

(Joins sheet 10)

Land division corners are approximately positioned on this map.

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HEBER VALLEY AREA, UTAH — SHEET NUMBER 7

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Land division corners are approximately positioned on this map.

HEBER VALLEY AREA, UTAH NO. 7

2 060 000 FEET

T. 3 S. | T. 2 S.

820 000 FEET

(Joins sheet 6)

(Joins sheet 11)

R. 6 E.

2 080 000 FEET

810 000 FEET

7

N

2 Miles

10000 Feet

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

HEBER VALLEY AREA, UTAH — SHEET NUMBER 8

(Joins sheet 4)

N

Scale 1:24000

2 Miles 10000 Feet 1 5000

1 ¼ ½ ¾ 1 0 1000 2000 3000 4000 5000

R. 3 E. | R. 4 E.

1 970 000 FEET

2 000 000 FEET

775 000 FEET

800 000 FEET

765 000 FEET

790 000 FEET

1 968 000 FEET

1 980 000 FEET

2000 AND 10000-FOOT GRID TICKS

T. 4 S. | T. 3 S.

UTAH COUNTY

UINTA NATIONAL FOREST

WASATCH MOUNTAIN STATE PARK

Pole Line Pass

Sandy Baker Pass

Bonner Hollow

Lime Canyon

Middle Canyon

Faucett Canyon

Mountain Sids Canyon

Powerhouse

Provo Deer Creek

16 19 20 21 28 29 30 31 32 33 1 2 4 5 6

MSD MRE RSD RO RRF RUF DBF BKF AGF HeD YaB StC CNF RRD CgC MaB RRE HFF HJE HeC StB MaD HGF BWE WBF GWF RRC AWF GAF HJD MaC HJC BLF

(Joins sheet 16)

(Joins sheet 12)

(Joins sheet 9)

(Joins sheet 12)

Land division corners are approximately positioned on this map.

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Land division corners are approximately positioned on this map.

HEBER VALLEY AREA, UTAH NO. 9

2 010 000 FEET

R. 4 E. | R. 5 E.

(Joins sheet 5)

800 000 FEET

T. 4 S. | T. 3 S.

(Joins sheet 8)

(Joins sheet 13)

(Joins sheet 10)

790 000 FEET

2 030 000 FEET

WASATCH MOUNTAIN STATE PARK

WMSP

WSMP

Midway

HEBER CITY
(county seat)

Memorial Hill

Donkey Ridge

Phosphate Hill

Dutch Hollow

Deer Fence Canal

Provo River

Snake Creek

Rock Creek

Spring Creek

Lake Cr

Coyote

Fairgrounds

North School

Central School

Wasatch School

Scale 1:24000

2 Miles

10000 Feet

9

N

(Joins sheet 6)

R. 5 E. | R. 6 E.

2 050 000 FEET

N

2 Miles 10000 Feet

1 5000

Scale 1:24000

0 0

¼ 1000

½ 2000

¾ 4000

1 5000

790 000 FEET

800 000 FEET

T. 4 S. | T. 3 S.

HEBER VALLEY

Coyote Canyon

Coyote Hollow

Lake Creek

Provo River

Provo River Canal

Timpanogos Canal

Humbug Canal

21 22 23 24 19 20

28 27 26 25 30 29

33 34 35 36 31 32

4 3 2 1 6 5

BPE BPF BTC BTD FLD CCD CBC CBD FLE LPF CDE WLD WLC WcC BeD2 CgB RdA Ca CaA RCC CgC WcD RaB Km Hr Hk Hm Ho St CgA BeD2 HeC MaC RdC BHF BAF HJC FA HWF CBB

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 14)

2 030 000 FEET

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HEBER VALLEY AREA, UTAH NO. 11

2 060 000 FEET

R. 6 E.

(Joins sheet 7)

800 000 FEET

T. 4 S. | T. 3 S.

(Joins sheet 10)

(Joins sheet 15)

2 080 000 FEET

790 000 FEET

11

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

HEBER VALLEY AREA, UTAH — SHEET NUMBER 12

(Joins sheet 8)

R. 3 E. | R. 4 E.

2 000 000 FEET

1 780 000 FEET

1 770 000 FEET

1 980 000 FEET

T. 4 S.

(Joins inset, sheet 8)

(Joins sheet 13)

(Joins sheet 16)

N

Scale 1:24000

2 Miles 1 0

10000 Feet 5000 0

¼ 1000 0

½ 2000

¾ 3000

1 4000

5000

UTAH COUNTY

WASATCH MOUNTAIN STATE PARK

UINTA NATIONAL FOREST

WASATCH MTN STATE PARK

DEER CREEK RESERVOIR

Thomas Canyon

Pole Canyon

Bear Canyon

Deer Creek

Cascade Spring

South Fork Deer Creek

Soldier Hollow

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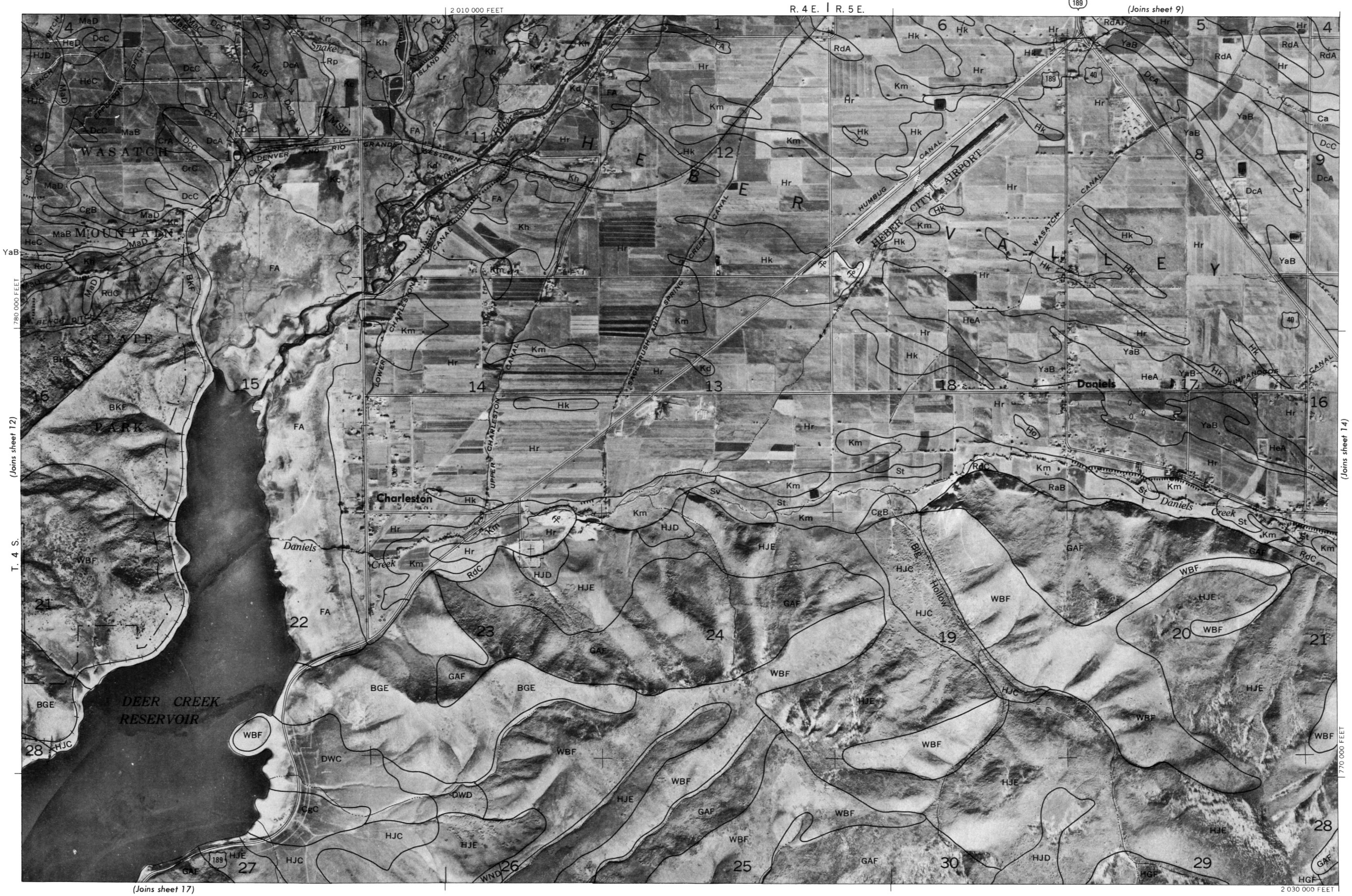
HEBER VALLEY AREA, UTAH — SHEET NUMBER 13

(13)



N

2 Miles

10 000 Feet

Scale 1:24000

1

5000

0

¼

½

¾

1

0

1000

2000

3000

4000

5000

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HEBER VALLEY AREA, UTAH NO. 13

(Joins sheet 10)

R. 5 E. | R. 6 E.

2 050 000 FEET

HEBER VALLEY

Center Creek

Lake Creek FA

Daniels Creek

Center Creek

Crooked Creek

TIMPANOGOS CANAL

T. 4 S.

780 000 FEET

770 000 FEET

2 030 000 FEET

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 18)

N

2 Miles

10000 Feet

Scale 1:24000

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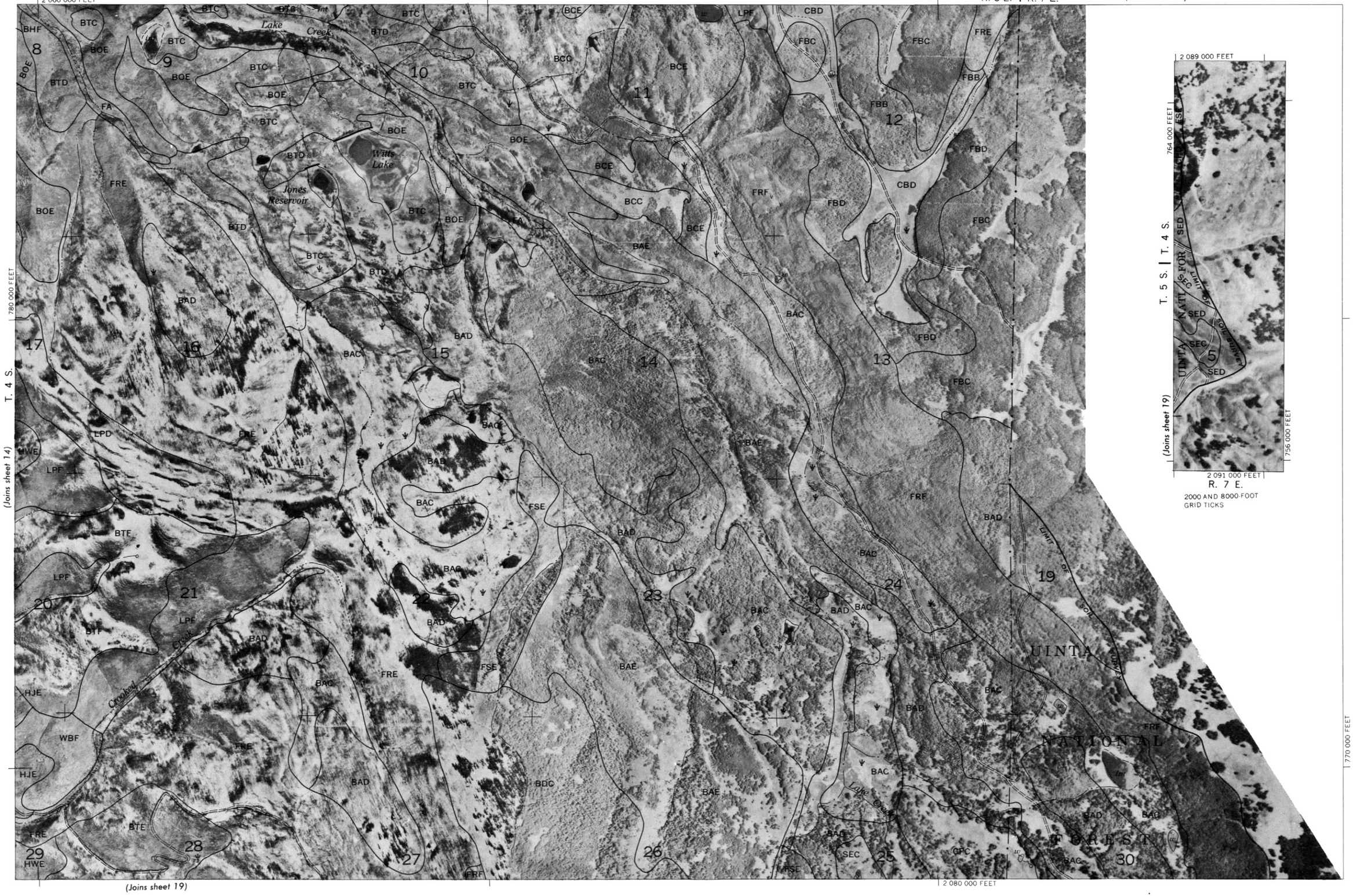
HEBER VALLEY AREA, UTAH NO. 15



Scale 1:24000

2 Miles
1
10000 Feet
5000
0
¼
1000
½
2000
¾
3000
1
4000
5000

HEBER VALLEY AREA, UTAH — SHEET NUMBER 16

(Joins sheet 12)

R. 3 E. | R. 4 E.

2 000 000 FEET

(Joins inset, sheet 8)

WASATCH MTN STATE PARK

DEER CREEK RESERVOIR

WASATCH COUNTY UTAH COUNTY

LIMIT OF SOIL SURVEY

UINTA NATIONAL FOREST

South Fork Deer Creek

Provo River

Hoovers Hollow

North Fork Long Hollow Ridge

Weeks Bench

DENVER AND RIO GRANDE WESTERN

T. 5 S. | T. 4 S.

760 000 FEET

750 000 FEET

1 980 000 FEET

(Joins sheet 20)

(Joins sheet 17)

Scale 1:24000

2 Miles 10000 Feet

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Land division corners are approximately positioned on this map.

HEBER VALLEY AREA, UTAH NO. 17

2 010 000 FEET

R. 4 E. | R. 5 E.

(Joins sheet 13)

760 000 FEET

T. 5 S. | T. 4 S.

(Joins sheet 16)

(Joins sheet 18)

(Joins sheet 21)

750 000 FEET

2 030 000 FEET

DEER CREEK RESERVOIR

Provo River

Hanks Canyon

Owens Canyon

Sams Canyon

Main Creek

Spring Creek

Round Valley

NORTH DITCH

Wallsburg

GAF WBF WND HJC HJE HJD GPF WPF YEC YED DWD DWC HGF CgA CgB CgC DcC WcC WcD BeD2 CrC CrA ChC Kc Kd Kh Lr MaB HeD HHF GMF BYF DBF RdC

17

N

2 Miles

10000 Feet

5000

Scale 1:24000

(Joins sheet 14)

R. 5 E. | R. 6 E.

2 050 000 FEET

T. 5 S. | T. 4 S.

760 000 FEET

750 000 FEET

2 030 000 FEET

(Joins sheet 17)

(Joins sheet 19)

(Joins sheet 22)

N

2 Miles

10000 Feet

1 5000

Scale 1:24000

0 1000 2000 3000 4000 5000

¼ ½ ¾

Land division corners are approximately positioned on this map.

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Land division corners are approximately positioned on this map.

HEBER VALLEY AREA, UTAH NO. 19

(Joins sheet 18)

(Joins sheet 23)

(Joins sheet 15)

(Joins inset, sheet 15)

2 060 000 FEET

760 000 FEET

750 000 FEET

2 080 000 FEET

R. 6 E. | R. 7 E.

T. 5 S. | T. 4 S.

R. 6 E.

U I N T A H N A T I O N A L F O R E S T

Bald Knoll

Lake Creek

Dry Can

Clegg Canyon

Center Canyon

Heber Mountain

SURVEY LIMIT OF SOIL SURVEY

Scale 1:24000

2 Miles

10000 Feet

5000

1

19

N

(Joins sheet 16)

R. 3 E. | R. 4 E.

2 000 000 FEET

740 000 FEET

730 000 FEET

1 980 000 FEET

(Joins sheet 21)

(Joins sheet 24)

T. 6 S. | T. 5 S.

N

2 Miles

10000 Feet

Scale 1:24000

5000

0

1000

2000

3000

4000

5000

1/4

1/2

3/4

1

Dry Lake

Provo Canyon

Provo River

North Fork Provo River

South Fork Provo River

Bear Canyon

Scott Hollow

Slide Canyon

Snow Slide Canyon

Davis Canyon

Bunnells Fork

Wildwood

Vivian Park

DENVER AND RIO GRANDE WESTERN

U I N T A H N A T I O N A L F O R E S T

WASATCH COUNTY
UTAH COUNTY

WASATCH MOUNTAIN RANGE

LIMIT OF SOIL SURVEY

DAF RRE RO BWE BWF HJC FA WBF BMF GAF BYF DBF GWF BKF DBE GPF GAD

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HEBER VALLEY AREA, UTAH — SHEET NUMBER 21

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Land division corners are approximately positioned on this map.

HEBER VALLEY AREA, UTAH NO. 21

21

N

2 010 000 FEET

R. 4 E. | R. 5 E.

(Joins sheet 17)

740 000 FEET

(Joins sheet 20)

T. 6 S. | T. 5 S.

(Joins sheet 25)

2 030 000 FEET

(Joins sheet 22)

Wallsburg

Round Valley

Bear Canyon Pass

WASATCH COUNTY
UTAH COUNTY

UINTA NATIONAL FOREST

WASATCH CO
UTAH CO

Scale 1:24000

2 Miles 10000 Feet

(Joins sheet 18)

2 050 000 FEET

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

(Joins sheet 21)

16 15 14 13 18 17

21 22 23 24 19 20

28 27 26 25 30 29

33 34 35 36 31 32

4 3 2 1 6 5

DWC DWD BMF GPF RSD RSC DBF RRE RRD RRC GMF RO RRD

DcC WcC ChC CgB BeD2 HeC CrA Km RdC St MaC MaB Kc GAF HJD HJC WSC WSD GeA CnC

UINTA NATIONAL FOREST

Cummings Canyon

Daniels Hollow

Daniels Canyon

Center Can

Station Creek

Thornton Hollow

Cabin Hollow

Main Creek

Maple Creek

Bidsom Bench

Big Glade

BOREN DITCH

FA DAF CPF

40

730 000 FEET

740 000 FEET

T. 5 S.

T. 6 S.

2 030 000 FEET

(Joins sheet 26)

R. 5 E. | R. 6 E.

(Joins sheet 23)

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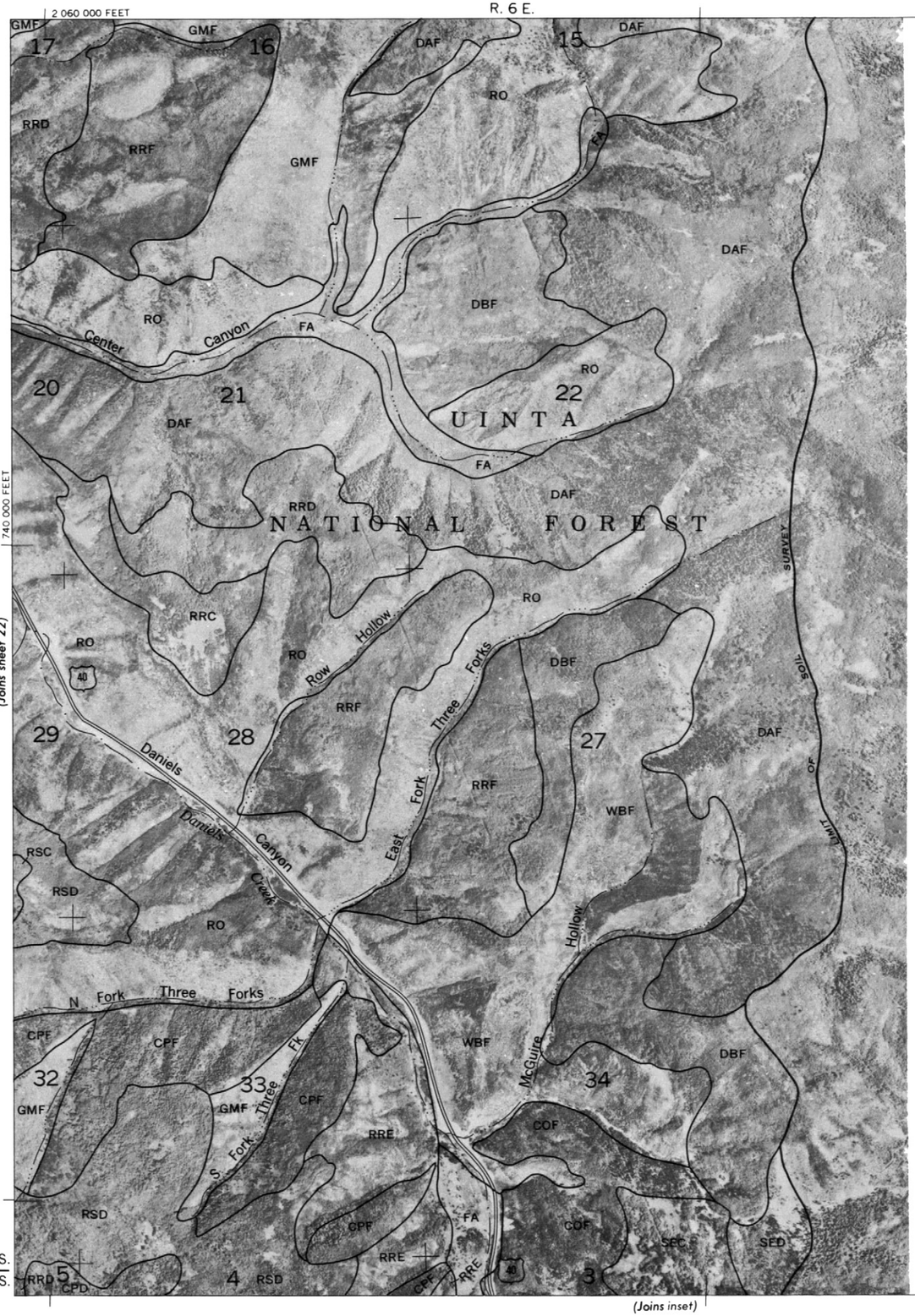
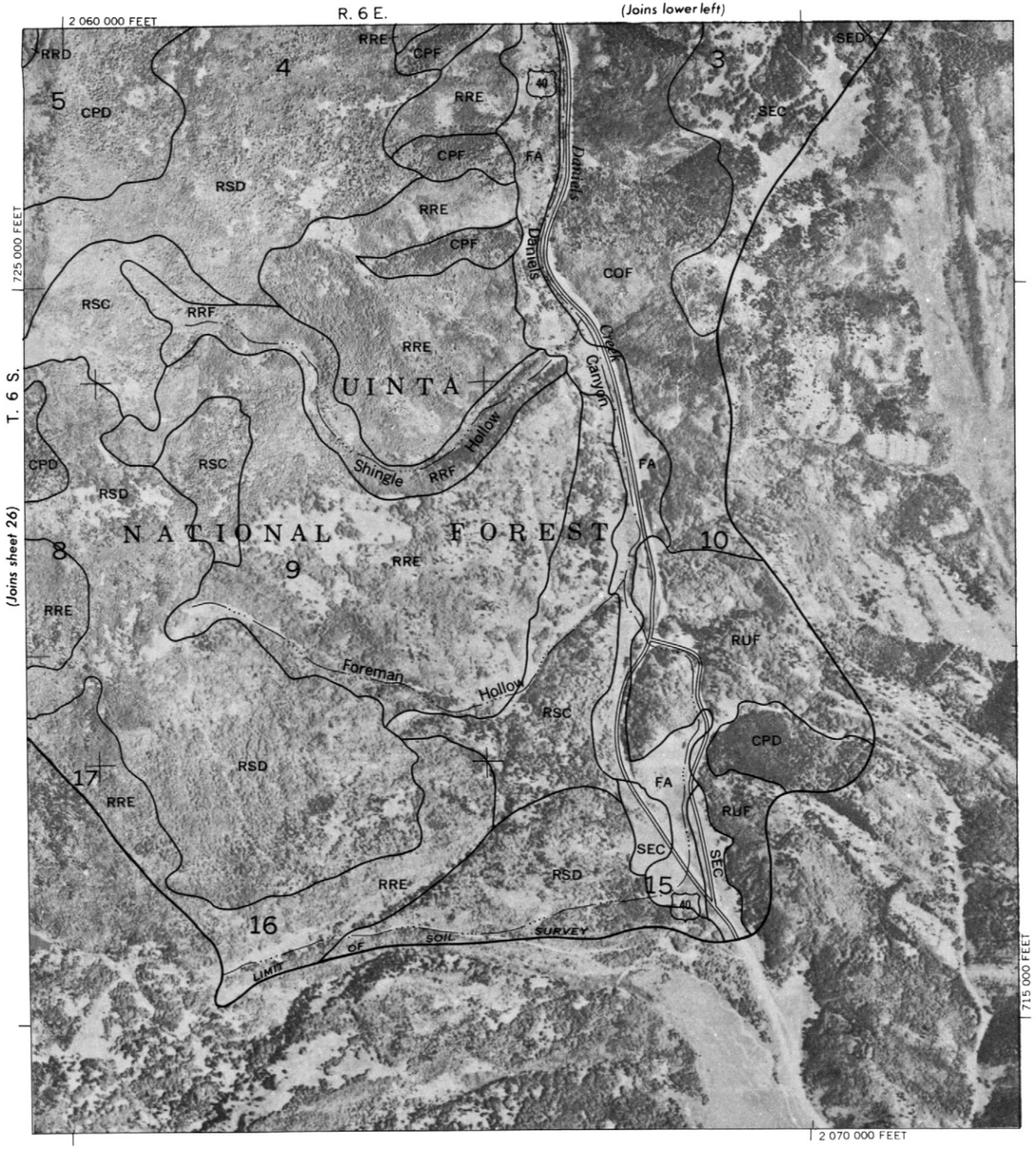
Land division corners are approximately positioned on this map.

HEBER VALLEY AREA, UTAH NO. 23





(Joins sheet 19)

2 080 000 FEET

N

2 Miles
1
10000 Feet

Scale 1:24000

1 5000 0
¼ 1000 0
½ 2000
¾ 3000
1 4000
5000

23

HEBER VALLEY AREA, UTAH — SHEET NUMBER 24

(Joins sheet 20)

R. 3 E. | R. 4 E.

2 000 000 FEET

T. 6 S.

(Joins sheet 25)

720 000 FEET

1 980 000 FEET

710 000 FEET

UINTA NATIONAL FOREST

LIMIT OF SOIL SURVEY

Burnetts Fork

Spring Hollow

Big

Shingle Mill Canyon

Heber Hollow

Left Fork South Fork Provo R.

Middle Fork South Fk Provo River

RO GMF GWF GAD FA DBE DBF HJC BMF

1 2 5 6 7 8 11 12

N

2 Miles 10000 Feet

1 5000

Scale 1:24000

1 ¾ ½ ¼ 0 5000 4000 3000 2000 1000 0

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Land division corners are approximately positioned on this map.

HEBER VALLEY AREA, UTAH NO. 25

2 010 000 FEET

R. 4 E. | R. 5 E.

(Joins sheet 21)

T. 6 S.

720 000 FEET

(Joins sheet 24)

(Joins sheet 26)

710 000 FEET

2 030 000 FEET

U I N T A N A T I O N A L F O R E S T

WASATCH UTAH

LIMIT OF SOIL SURVEY

Left Fk South Fk Provo R.

South Fork Provo River

Middle Fork

Right Fork

Left Fork

Little Valley

Bald Knoll

BMF RO GWF HJD WBF DBF GMF GAF WSC RRC RRE RSG RSD COF FA CO

25

N

2 Miles

10000 Feet

1

5000

Scale 1:24000

0 1000 2000 3000 4000 5000

(Joins sheet 22)

R. 5 E. | R. 6 E.

2 050 000 FEET

N

2 Miles

10000 Feet

1 5000

Scale 1:24000

(Joins sheet 25)

0 0 1000

¼ 2000

½ 3000

¾ 4000

1 5000

710 000 FEET

2 030 000 FEET

720 000 FEET

T. 6 S.

(Joins inset, sheet 23)

Main Creek

Second Set

Wheeler Creek

Petes Canyon

Glen Cabin Creek

Service

Strawberry Peak

Bald Mtn Bench

Schoolhouse Creek

Beautiful Creek

Wing Flat

UTAH COUNTY

U I N T A

N A T I O N A L F O R E S T

LIMIT

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 22 23 24

GAF WSC WSD BKF DBF RSC RRD RRC RRE RSD CPD GMF GAD RRF RO RUF SED

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